THE EXPERT PAINT MIXER

A. ASHMUN KELLY

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The EXPERT PAINT MIXER

DESIGNED FOR THE USE OF HOUSE AND STRUCTURAL PAINTERS

GIVING

A COURSE OF INSTRUCTION IN THE PREPARATION OF PAINTS USED FOR INTERIOR AND EXTERIOR WORK WITH DIRECTIONS FOR APPLYING THEM

AND WITH WHICH COURSE ARE INCLUDED CLEAR AND HELPFUL OBSERVATIONS ON THE THEORY, NATURE AND ORIGIN OF COLOR

DESCRIPTIONS OF BASES, PIGMENTS AND LIQUIDS EMPLOYED IN THE COMPOUNDING OF PAINTS WITH MANY USEFUL TABLES AND SUGGESTIONS OF A PRACTICAL NATURE

By A. ASHMUN KELLY

AUTHOR OF THE EXPERT SERIES OF BOOKS FOR HOUSE AND SIGN PAINTERS, WOOD FINISHERS, PAPERHANGERS, INTERIOR DECORATORS, CALCIMINERS

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CHAPTER I

THE THEORY, ORIGIN, AND NATURE OF COLOR

Aristotle, writing two thousand years ago, called attention to the fact of certain colors not being susceptible of production by admixture of other colors; in other words, they are primary colors, from which all other colors may be formed. He called attention to the colors produced by a rainbow as being those "which, almost alone, painters cannot make: For they compound some colors; but red, green and violet are not produced by mixture."

A discussion of color theory would involve the making of a book, and there are already books covering the subject; hence we will give simply a brief explanation thereof, and in the plainest terms.

To become an expert color mixer one needs to know the origin of colors, as well as their nature and coloring qualities. We know that there are three colors which we cannot produce by mixing any other colors together; these are red, yellow and blue. We also know that with these three PRIMARY COLORS we can produce an almost endless series of colors, hues, shades

and tints. We may include with the three primaries BLACK and WHITE; the one representing the condition produced when absolute darkness prevails, the other when all the rays of sunlight combine. We can approximate black by adding together red and blue in certain proportions; try this, and you will be surprised, perhaps, at the depth of the black possible by this means; some experts claim that they get a blacker black than any of the blacks represented in pigments. But black and white are known as NEUTRAL COLORS. They agree in harmony with all other colors, just as gold does in decoration.

The generally accepted theory of color is, that sunlight is composed of a certain number of pure or primary colors which, when combined, form white light; in the absence of that light color does not exist. If it were possible to totally exclude every vestige of sunlight from the earth nothing would be visible; there would be only an intense black void. But as this is not possible, on earth at least, there is, even in the darkest possible condition of things, a partial presence of light, and enough to produce what appears to be black. Hence we say "the night is black as coals."

When a beam of sunlight is directed through a glass prism it is separated into its component color parts, red, blue and yellow, these in several gradations of

color or hue. The rainbow also is a prism, even more beautiful in its color analysis than the glass prism.

Now we come to the next series of colors, which are known as the SECONDARIES. Taking the pure primaries, with red and blue mixed together we get purple; carefully examine purple and you will easily discern both the red and blue in it. Then by mixing blue and yellow we get green; the expert sees both these primaries in his green color, his color vision being extremely acute. It is this faculty that we wish you to obtain through a study of this book. Resuming, let us take the two remaining primaries, yellow and red, and mix them together; orange is the result. And now we have formed the three secondaries, let us take up the third series, known as the TERTIARIES. These are Russet, Olive, and Citrine. Russet is formed from orange and purple; Olive from orange and green; citrine from green and purple.

All further colors are of necessity formed from these three sets of colors; or, more correctly, from the primaries. But we shall not call them colors, excepting in our shop language. Because we shall have tints, hues or shades of the three sets of colors given. These may be effected by adding white or black to the colors, whites giving the tints, and black the shades of colors. Or we may alter the colors by adding more or less of one of its component parts; for instance, we may add more yellow to the blue,

and get a lighter hue of green. Or more of the blue and get a darker shade of the green.

By adding a little of a color to white we get a TINT of that color. By adding black to a color we get a shade of that color. The term HUE applies to the shade of a pure or unmixed compound color; thus, by adding more of one of its components to a color you alter its hue, and deepen it or lighten it.

Here is a little table of color terms that it would be well to commit to memory.

COLOR is any one of the primary, secondary, or tertiary colors.

HUE means a particular tone of color; thus, there are purple-blues, orange-yellow, etc.

TINT is the name of a color produced by adding a little pure color to white.

SHADE relates to the darkened effect of a color when black has been added to it.

GREY and GRAY, variously spelt, mean one and the same thing, though some claim that the two spellings mean a difference of color mixing; thus, grey is made when white is slightly darkened by the addition of black. Gray, by the tinting of white with blue, black, and a trifle of red: This latter is the true so-called French gray.

A *hot color* means red, which is the color of fire. And it is the opinion of decorators that red walls

really add to the warmth of a room; perhaps the feeling of warmth is purely imaginary.

A *warm color* applies to yellow and its modifications. Yellow is always advised for cold rooms, or those having a northern exposure.

A *cold color* is typified by blue, the color of ice, as some say. Blue is suggestive of coldness; it is suitable for southern exposed rooms.

Green is generally regarded as a *cool color.*

CHAPTER II

A DESCRIPTION AND ENUMERATION OF PAINTERS' COLORS

The artist has his "palette of colors." So also the structural painter, but whose palette is much more restricted as to number of pigments. Give him the umbers, siennas, yellow ochre, Vandyke brown, yellow chrome, green, red, blue, black, and the whites—white lead, zinc white, etc., and he will be abundantly supplied. Of course there are divers reds, blues, etc., which he must have, thereby somewhat extending his palette, but on the other hand he can, when of necessity, do with less. For instance, in the place of Vandyke brown he can make shift with a mixture of burnt umber and black. And sienna is simply a form of yellow ochre; clay and iron, both, only in different proportions. And as previously stated, he can make black with red and blue.

Taking these painters' pigments in hand let us get acquainted with them. We find them in two classes as regards nature and origin; there are the earth or mineral pigments and the chemical pigments. And, further, we may subdivide these classes; by mixing some chemical colors to the mineral colors we get a

third class, namely, Indian red, Venetian red, Tuscan red, etc. Then, by adding some inert pigment matter to a chemical color we get such colors as chrome green.

Umber is an earth or mineral color, clay strongly colored with iron. While some of the natural umber is prepared and used in painting, its color and color value is greatly improved by subjecting it to heat or fire, by which is produced burnt umber. The best grade of umber is found in Europe, and is known as Turkey umber; the umber found in America is much inferior. The true Turkey umber has a warm violet-brown color; some umbers have a yellow tone. An imitation umber may be made from a mixture of red, yellow and black; but the color thus made would be lacking in the clear transparency of true umber. However, the imitation may be used in many cases with perfect satisfaction.

Used alone, as a coating, umber deteriorates in the sunlight, fading to a rusty brown. It is very seldom used that way, its chief uses being in stains and in graining, also in oil paints. In paint, mixed with white lead, it gives a very pleasing drab.

Raw umber is seldom used, but makes a rather good tinter with lead or zinc, producing a soft grayish color.

Vandyke brown is probably derived from the decomposition of lignite or brown coal, and in house painting it is chiefly useful for imitating black walnut,

the feather effect in mahogany graining, and for stippling. With white lead or zinc white it gives muddy tints or colors. But it is a durable pigment where it can be used, and is perfectly neutral when used with other pigments, oil, etc. There are several varieties, all stable and neutral. Vandyke brown is easily imitated with black and burnt umber.

Yellow ochre comes in several grades, that from France being the best. The American yellow ochre is far inferior to that of the French, as concerns paint, yet the American ochre has three times the tinting strength of the French. The difference between the two in all other respects, however, is very important: The French ochre has a silicate base; whereas, the American ochre has a clay base. It is because clay readily takes up water that such ochre is not fit for paint. It can draw moisture while incorporated with the paint materials, and this causes such a paint to blister and scale. Then as to tinting lead, the American ochre gives a dull tint, and the French a bright, clear tint. Nor does the American ochre spread or cover so well as the other does.

The best grades of French ochre have a bright color, similar to that of yellow chrome. It should contain at least 20 per cent. of iron oxide, and not more than 5 per cent. of lime in any form. (U. S. Government specification.)

Never prime exterior woodwork with yellow ochre,

although it is a common practise in some parts of the country. Such priming will cause scaling of the paint in course of time. As such priming is mostly done with the cheap ochres the result is the worse on that account; a French ochre would probably not cause paint-scale, but it is a chance only.

The so-called "Golden Ochre" is of various grades, the best being French ochre lightened with medium chrome yellow.

Sienna comes in the natural state and also in the burned or calcined. Sienna is simply a form of ochre that is somewhat browner in tone. Some class ochre and sienna under the same head, but for trade uses we had better separate the two, ochre and sienna. When yellow ochre is calcined it gives a red tone. So too when sienna is calcined we have a bright red of a very handsome hue. In this form it is very useful for staining and for graining. It is seldom employed as a tinter of white lead or zinc white, but its strength is tested by coloring some white. As it is most useful in stains and grainers' work, its transparency is the important point, rather than its tinting strength. Try it by spreading very thinly on a prepared ground of pale yellow, as in graining. Raw sienna is used in imitating light oak, and for darker shades of oak a little burnt umber or drop black is added. The burnt sienna is useful for imitating cherry and mahogany.

I have stated that sienna is seldom used for tinting white lead or zinc white; this should be qualified, by saying that house painters seldom so use it, but that decorators find it useful for decorative work. The raw sienna makes very soft, pleasing yellow tints. The Italian sienna is the best.

Chrome yellow comes in several shades, as the pale or lemon chrome, medium shade yellow, dark yellow and orange yellow. The medium shade is that most used by house painters, and it may be added that very little yellow chrome finds use in the house-painting shop. It is rather a color for decorators' use.

Its trade name is lead chromate, the light shades containing, usually, lead sulphate as well as lead chromate; the darker shades or orange chrome contain some basic lead chromate. We shall find chrome yellow adulterated, very often, as this is easily accomplished and the pigment pass for good. Pure lead chromate should show an orange yellow, no matter how made. So strong in tinting power is pure chrome yellow that as much as 50 per cent. of an adulterant might be added and the fact pass without detection among painters.

Of the reds used in house painting the most important are the humbler ones, such as Venetian red or Indian red. Indian red is simply iron oxide. But it is a very beautiful type of that color. The Tuscan red, once used in painting window sashes, and for

painting railway passenger cars, is simply Indian red altered with some rose pink, or with an aniline dye. Hence it is not so stable as the pure Indian red. But there is a genuine Tuscan red, made by calcining iron oxide to a purple hue, in which condition it is Indian red; it is then improved in color by the addition of alizarine lake, after which it goes through other processes of manufacture, and is finely ground. Imitation Tuscan red is made from a base of whiting or other suitable white base, then is colored up with aniline dye. It gives a more brilliant color than the other, but is not durable.

Venetian red finds its chief use in roof painting, being useless for coloring white lead with, as it fades out; it does better in zinc white, however. The Government requires of a Venetian red that it shall contain not less than 40 per cent. of sesquioxide of iron and not more than 15 per cent. of silica; the remainder of the lime content to be not capable of taking up water of crystallization. The best grades contain lime sulphate, the inferior grades lime carbonate; that is to say, gypsum in the one case, whiting in the other. The more iron oxide and the finer ground, the deeper the color and the better the covering capacity.

Of vermilion little needs to be said, as structural painters do not use it. However, decorators and sign painters, also vehicle painters, use it largely. There

are the English, the Chinese, and the German vermilions, the American vermilions being simply imitations. The latter can be made from red lead colored with eosine red aniline. American vermilion is a chromate of lead, fairly permanent, a poor coverer, and used in cheap work, such as in painting wagons and agricultural tools. The Para reds are better and much used now.

What is called "light red" is calcined yellow ochre. It is permanent and dries well.

Of blue there are several kinds, but that most used in structural painting is Prussian blue and ultramarine blue. Prussian blue is a chemical pigment, a very strong color, useful for tinting lead, but not a good body-color, being too transparent. While ordinarily permanent, yet in a strong light and too long exposed thereto, it shows a tendency to fade.

Under the head of Prussian blue are placed all similarly made blues, such as Chinese blue, Antwerp blue, etc. They all analyze the same, yet when used for tinting purposes you will see that they differ. Prussian blue gives a light blue shade with white; but the color or tint is slightly purplish and grayish. The Chinese and other blues of this order yield a clearer and truer shade of blue. There is also a difference in the coloring powers.

Celestial and Brunswick blues are simply adulterated or reduced grades of Prussian blue, containing perhaps as little as 5 per cent. of real Prussian blue.

Ultramarine blue is another chemically prepared pigment. Chemists say "it is of unknown constitution, being made by heating clay, soda, sulphur and charcoal together. It appears to be a complete silicate of aluminum and sodium." This is given here mainly to illustrate the wonderful manner in which some of our pigments are produced. As ultramarine blue contains sulphur it is not safe to use in white lead or other paint substance containing lead salts. The pigment has very little use in the paint shop, though in interior work, as in water colors, in decorating, it is largely used when a blue tint is required; it does well in lime compounds, where Prussian blue does not.

Green is one of the most used of the pigments in house painting. As a chrome green it is adapted for window blinds principally. For this purpose the green need not be pure, but may contain a large percentage of adulteration in the form of barytes, etc. Like Prussian blue, it has great covering power, which accounts for its good covering quality when used as a body color. Green has the reputation of fading out, when exposed to the weather and sunlight, but this fault is less pronounced in properly made greens. A pure chrome green contains Prussian blue, lead chromate and lead sulphate. Chrome green may be made in two ways; by mixing together Prussian blue and chrome yellow. Or by precipitating the two pigments

together, which is done in the factory, producing a more stable pigment. Where entire permanence is required chromium oxide is used, but this pigment is not common. Green made from ultramarine blue and zinc is also made.

You will observe, when mixing a pot of ordinary chrome green, and letting it stand some hours, that the yellow settles down and the blue comes to the surface. This occurs when the two pigments have been mechanically mixed. On the other hand, a properly made chrome green will not show this yellow, but only very small particles of blue and green.

Paris green was, years ago, much used in painting inside Venetian blinds, but its very poisonous nature caused it to be discarded. Added to chrome green it is thought to improve or liven the color. Paris, or Emerald, green is an extremely poor covering color.

Ultramarine green finds some use with the interior decorator, or frescoer, but it is too transparent to be used in oil color. It is a permanent color.

Of the blacks used in painting we have two, drop black and lampblack. Drop black is popularly supposed to be produced from ivory, calcined, but it seldom is. It is most likely to be made from bones, calcined. Ivory drop black has a rich, velvety black hue, and bone black a reddish cast of color. Pure ivory drop black resists strong sunlight better than any

other of the carbon blacks excepting lampblack. This is one of its chief merits in carriage painting.

From the above we see that the two blacks will not produce the same color effects in tinting white. Lampblack produces a cold tone of gray, while ivory drop black gives a softer tint. When you have a gray tint to make add a little burnt umber to the black. This softens the tint.

Lampblack is a finely divided form of carbon, the product of burning oils, in the form of smoke. So well known is the durability of lampblack paint that we need not say more on that head. Carbon, whether in the form of a diamond, or that of charred wood, is practically indestructible. As a paint it is not only very durable, but withstands heat and cold, storm or shine, better than any other pigment we use. But it is not faultless; it is a poor drier, hence we are apt to over-dose it with japan driers. By adding some Prussian blue to it the self-drying quality is greatly improved or helped.

Natural gas lampblack, if free from minerals and unburned oil, and having a good color, is a very desirable black pigment.

For tinting purposes it is thought by some that lampblack adulterated as much as 50 per cent. will give better satisfaction than a pure form. The price, however, would likely be that charged for the pure article.

CHAPTER III

THE WHITE PIGMENTS USED IN PAINTING. INERT PIGMENTS. THEIR QUALITIES AND USES IN PAINTS

The chief or most important pigment used in painting is white lead, with zinc white a close second. But as there are other forms of white lead we must use terms of paint chemistry. Hence we shall call the white lead we now have in mind, that form most generally used, basic lead carbonate, or corroded lead. It is produced in various ways, but the old Dutch method is the best. It should be very finely powdered when dry, white, and cover well. If it has a yellow tinge it has been over-heated in grinding. If of a pink cast, it contains some red lead. If grayish, it contains uncorroded lead.

What is called the quick process lead is made by spraying finely powdered lead with an acid, and such lead is very satisfactory, though most will say that it is inferior to the Dutch process lead. It is very fine and white, and covers well, hence should be quite satisfactory.

Sublimed lead is technically known as basic lead sulphate. Briefly, it is lead ore containing some zinc

which cannot be entirely removed. About 10 per cent. of the zinc remains in the white lead product, and about 90 per cent. lead sulphate. Efforts have been made to gain popularity for this form of lead pigment, but as it has no advantages over basic carbonate of lead, and no lower in price, there would seem to be little reason why people should prefer it. Its texture is harsh, it is not elastic as white lead proper is, it has poor covering power, flows badly under the brush, and does not yield a smooth surface in painting. It is said that the addition of a small percentage of whiting will improve its texture, which is no doubt true. Some say that it lacks body, and also that it becomes brittle and cracks.

For lead sulphate as a pigment it may be said that it is non-poisonous, and that under the influence of sulphur gases it will not darken, as lead carbonate does.

Another white, similar to lead sulphate or sublimed lead, is known as zinc lead; it is composed of equal parts of lead sulphate and zinc oxide. It is made from ore containing lead and zinc. It is made in the same manner as sublimed lead. You will hardly meet with it excepting in ready mixed paints. It has a good body, but does not work well under the brush, and its texture is even harsher than that of sublimed lead. Also, it is poor of color. Strangely, it carries about 20 per cent. more oil than either white lead or sub-

limed lead, and as the ability to take up oil is a very useful feature, it would seem that zinc lead should not be without merit. But paint made from it and used on outside work is very liable to crack.

As lead sulphate lacks covering power, paint makers add a little borax to it, to overcome this fault.

Whiting is a very useful substance in painting work. As a putty for glazing windows it is well known for its tenacity and hardness; when well made, from raw linseed oil, it resists the weather for many years. Yet, as a paint base, it is of little value. Whiting is chalk, a form of lime, hence is not an inert pigment as often classed, for its lime content acts upon the oil and lead, when mixed therewith to form a soap, making a paint poor in durability. As a putty, as previously noted, this action does not occur apparently, for the composition is durable. Again, when a portion of whiting is used in oil paint, with lead as the base, we find that it has worn well, showing great durability. What then shall we conclude? Theoretically a whiting oil paint, with lead as the base, should deteriorate on account of the soap-making power of the whiting. In practise we have found that such is not the case. But there are exceptions, and these must form the rule.

Whiting, in chemistry, is calcium carbonate, or carbonate of lime. It is made from the chalk rock. The finer the grade the bulkier, or the less in weight for a

certain amount. Take a gallon of precipitated chalk, the finest form of whiting, and weigh it; it will weigh nearly 3 lbs., while a gallon of ordinary so-called gilders' whiting, the kind mostly used and a very good grade, too, will weigh nearly twice as much. Paris white is even heavier than this, or about 7 lbs.

Whiting is used extensively for making calcimine or water paint. While it seems very dark in bulk, yet when mixed with water and white glue and applied to the walls it seems very white. The addition of a little blue will make it appear still whiter. Take a small sample of dry white lead and one of dry whiting, place them side by side, and you will note the difference of color and texture. Place here also a little pile of dry finely ground silica and one of fine barytes, and these will look very much alike; the barytes and white lead particularly. But add a little raw linseed oil to each pile, and mix it a little: Then note the difference. The white lead remains white, so would zinc white if tried in the same manner. But the others will appear very gray, and the demonstration will especially show up the barytes, which has been a much-used adulterant for all forms of color and paint bases, especially lead. Its bulk and weight approximates that of white lead, and it therefore served admirably to extend the costlier lead. This leads us to say that when not used as an adulterant the barytes serves as a very useful ingredient in the

making of a white lead oil paint. This matter will be treated at length in another place.

Barytes or baryta, of which we have been talking, is very fine of texture, quite white or without color, and is inert, or without reaction when mixed with other paint ingredients. It takes stains well, and is a useful extender for pigments, causing them to cover more surface than they would if used in the natural state. Thus, most of the pigments used in painting may be extended one-half or more with baryta and pass for the pure thing. Then too it is useful when it is desired to carry certain organic coloring matter, such as rose pink, for instance.

Inert pigments are those which, mixed with oil to form a paint, either alone or in connection with other pigments, do not act chemically upon those other substances. They are neutral or inert. When lead, zinc, chrome yellow, Prussian blue, etc., are mixed with linseed oil a chemical union takes place, and chemical reactions occur between the oil and the pigment, which of course is injurious to the paint. When the earth or mineral pigments, such as ochre, umber, etc., are mixed with the oil, there is a purely mechanical union and no reaction; it is just like mixing sand and water together. In addition to sienna, ochre, umber, iron oxide, Venetian red, etc., as neutral pigments, there are also baryta, silica, terra alba, gypsum, soapstone or steatite and feldspar. Whiting is sometimes

listed as a neutral, but as its alkaline nature causes it to act upon oil it can hardly be placed in this category.

What occurs when we mix chemically active pigments and neutral pigments together to form a paint? Just what might naturally be expected, there will be a greatly diminished chemical reaction. Hardly any at all. As an extender gypsum is perhaps the best to use, it is inert, of low specific gravity, is easily ground with other pigments, and does not settle very much in the paint pot. Its weak point is that when water gets to it the paint is apt to liver up. To explain this term, the paint, setting for some hours, say over night, will become thick, like stiff jelly.

Now we come to zinc white, a neutral or chemically inactive pigment or base that is white lead's rival. It is not poisonous; you perhaps have used zinc ointment, a mixture of zinc oxide and petroleum jelly. In France the use of white lead in painting is not permitted. But the danger from using white lead paint is much exaggerated. The writer does not consider that there is any danger at all, unless it be in the vehicle paint shop, and not there if the workman will be careful. Zinc white has many merits as a paint base, but it also possesses some serious faults too. Its virtues are, that it is not poisonous; it is a very white pigment, so that when we wish to make an extra good white job we make the last coat or two entirely of zinc. Its faults are, that alone as a paint it scales

or cracks. It is a hard metal, not elastic like lead, hence cannot contract and expand and so escape deterioration. It is bulkier than lead, carries far more oil, hence spreads differently, and one not knowing how to use it would say that its covering power was poor; whereas, it needs only to be rubbed out less, and pound for pound will then do about as well as white lead.

It should be added here, as it was not told under the proper head, that white lead paint has the serious fault of chalking, the result of chemical action, the forming of a soap of lead. Now, if you will add some zinc white to the lead, say any amount from 10 lbs. to 50 lbs. to the hundredweight of white lead, according to climate or location, as at seashore or inland, the brittle zinc white will modify the soapy white lead and harden it, so that it will not wash away by chalking. In other words, the fault of one corrects the fault of the other. Lead is soft, zinc is hard. To still further help matters add some inert substance of a different sort from zinc white, and barytes answers the purpose very well. In this way is obtained a paint for exterior work that some think ideal.

There are two methods of making zinc white, that known as the French process, and the other that called the American process. The best "French process" zinc white is made in America, and this process con-

sists in preparing it from the pure zinc metal called spelter. The so-called American method is to treat the lead ore direct. Of course the French zinc white is the best, it is whiter and finer of texture. For finer work use the best French, but for ordinary exterior painting the other kind does well. Some brands of zinc white contain a small percentage of lead sulphate, but this is not considered to injure a paint containing it, either for inside or outside work.

Chinese white, sold in tubes for artists' use, is the French zinc under another name. Cremnitz white is the selected white lead ground in damar varnish. Florence white is French process zinc white, ground in damar varnish, and used for doing enamelled woodwork.

We come now to a remarkable white pigment that is being used extensively for making flat wall paint. It is called lithopone. It is a zinc sulphide white, looks like zinc white, but has a heavier gravity. It does not take up oil as largely as zinc white does. It covers well, spreads well under the brush, is not affected by sulphur or other gases. It is a permanent pigment of itself, but is mixed with other pigments which change its character in this regard. The best grade of lithopone that is to be used as a paint is the Green Seal, which is made up of 30 per cent. zinc sulphide, 2 per cent. of zinc oxide, and 68 per cent. of barytes. If you will drop a little diluted hydro-

chloric acid on lithopone there will be the odor of a burning match, indicating sulphuretted hydrogen. It will also effervesce. Lithopone paint must not be used in connection with white lead paint; that is to say, it will not do to apply a coating of lithopone over a coating of white lead.

We have now passed in review the various white pigments, in order to get acquainted with their respective qualities. For it is important to know the substances that you have to do with in the mixing of paints and colors. It is unfortunate that so many painters know very little about the nature and origin of these things. This is why they cannot mix colors or colored paints successfully. They may be excellent brush hands, but poor mixers, because they have had no experience in mixing and do not understand the pigments they would use.

CHAPTER IV

DESCRIPTION OF WHITE LEAD AND ZINC OXIDE

Brief accounts of these two important paint bases were given in the preceding chapter, but it is necessary to present a more elaborate account in order to give the interested reader working data from which to make up his paints. The painter sometimes has trouble with his white lead or zinc white paint, and he cannot get at the cause, owing to lack of knowledge concerning the nature of the pigment. To him, white lead is white lead. He does not know that there are several forms of white lead, some fit for his purposes, some not fit—some good, some bad. The paint chemist will tell you that "good white lead will not differ materially in its composition by whatever process it is made, but may differ seriously in its physical character, and in its fitness to produce a substance adapted to the uses to which white lead is applied." So it is necessary to explain this enigma. Good white lead may be a compound of two kinds, one containing two molecules of carbonate of lead, the other three molecules. Or, one part of hydrate of

lead and two parts of carbonate of lead; and one part of hydrate and three parts of carbonate of lead. The latter is in the proportion of 75 per cent. carbonate and 25 per cent. hydrate of lead. The latter is generally accepted as the correct formula for a good white lead. All of which has no meaning for the layman, so we must explain further. The hydrate of lead and the linseed oil in which it is ground unite to form a varnish; it is transparent and has no covering power. But the lead carbonate and oil unite to form an opaque compound having neither body nor covering capacity. In this compound the white solid carbonate is held in feeble mechanical suspension. So it is plain to see that neither of these combinations serve as a good paint. What then? Unite the two and you get the best paint material possible. You get the perfectly formed white lead. Now, if there should occur any variation in the proportions of hydrate and carbonate as given the white lead will not prove satisfactory. You will have trouble in the using of it.

Regarding processes of manufacture, we have just read that "good white lead will not differ materially in its composition by whatever process it is made." That is to say, it will be white lead or basic lead carbonate. But all "good leads" on the market are not equally satisfactory in some respects. In the nature of the case, it must be so, for no white lead is manufactured in an ideal way; that has yet to be

discovered. But given a white lead worthy of being called good, and therewith we must be content.

The best white lead will be found of very fine texture, smooth, and white, without trace of color. Whiteness indicates perfect corrosion and absence of impurities and discolorations. If your lead has a blue cast, it has been blued to make it appear whiter than it really is. If the white lead shows a yellow tint, it has been burnt in the grinding, or foreign matter is present; in either case the lead shows poor manufacture. To grind white lead to the utmost fineness requires the maximum of time and increased wear and tear of the machinery. Also, it lessens output and takes more oil. By grinding it rather coarse the grinder saves money, but loses in reputation. You will always find such lead as this very thin. Properly ground, the lead will be stiff.

But the lead must not be too finely ground, for that may cause a grayish cast of the lead. And if too closely ground the mill will overheat and the lead produced will lack body, on account of saponification of the oil and lead.

White lead will differ in quality according to the metal lead used. A metal lead containing more than a mere trace of foreign metals will not make good white lead. In close association with lead we find copper, iron, zinc, and some other metals, but not an ounce of silver to the ton of lead, according to the chemist.

White lead is easily adulterated, but adulteration is not common as once it was. Some years ago some samples of "white lead" were tested and found to contain not even a trace of white lead. Such a compound would fail to deceive any practised painter. The most favored adulterant would be barytes, because it resembles white lead in gravity. If whiting were used the adulteration would be more evident, and the same with any other white pigment of low specific gravity. However, such adulterated leads are commonly branded as compound leads, not pure white lead. For some uses, and when the price is correspondingly low, compound leads have their legitimate place in the paint shop, as we shall see later on.

What is known as pulp lead is white lead ground in water, instead of oil. Such pulp weighs from 12 to 20 lbs. to the gallon; linseed oil is added to the pulp lead and the mass is churned as cream is churned, in order to form a union of the oil and water and lead. In a short time the lead and oil and some of the water unite and fall to the bottom of the churn, the free water rising to the top, being then drawn off. The resultant white lead, or pulp lead as it is called, is packed in kegs, just as ordinary white lead is, and is sold as white lead. It is white lead, true, but you will not buy it in preference to the carbonate of lead ground in oil. Few painters like it. None, probably. Because of the water in it, maybe.

Taking pure lead carbonate, or as we would say, the best white lead in oil, and thinning it up to the proper consistency with linseed oil, thus overcoming its chemical reaction, we shall find that it covers the surface that we wish it to cover, with satisfaction; it will prove opaque and white, unless we should add coloring to it. It will prove stable in pure air, as well as white if used without color; in fact, white lead paint uncolored, on exterior work, getting the benefit of the sunshine, will become whiter with time, owing to the bleaching out of the yellow linseed oil. But it is liable to deteriorate under the influence of impure air, becoming dark or of a dingy brown where sulphurous gases come in contact with it. For this reason white exterior paint will not do where there is much coal gas, nor about horse stables. In such cases the lead paint had better be colored. The action of gas upon white lead paint is to produce lead sulphide, which is dark. And when white lead oil paint is used where there is insufficient sunlight, as in dark rooms, the paint will become discolored, turning to a dirty yellow. Paint a board with white lead in oil and place it in a dark place for some time, or until it becomes quite dark, then place it where it can have the sunshine and air every day for a period, and the paint will return to its original whiteness, or approximately so. The fact is due to the chemical action that has taken place; the black lead sulphide,

under the influence of sun and air, has been oxidized to lead sulphate. From which you may see how very interesting is the chemistry of paint. Another thing, if you should add too great a quantity of driers to exterior white paint it will turn yellow or light brown, because the action of driers on the oil is like the action of the overheated rolls that grind the white lead, it is burnt. As raw linseed oil and white lead too are self-driers, to a large extent, the paint formed from the two needs very little assistance in the drying, for in addition they have the oxygen of the air to aid them, and this indeed is what does cause the drying of the paint, the taking up of the oxygen by the oxygen carriers of the mass.

It is better to use white lead that has been made for some time, rather than that which is rather fresh. It is more economical, as the fresh is very much thinner than that which has stood for some time, whether in wood or metal; if in wood, then the wood has absorbed most of the oil; if in metal, the oil has risen to the top, leaving the solids beneath. When the writer was apprentice imported English white lead was considered to be the best form of that pigment; it went farther, as the saying is, and was economical to use on that account. But in all other respects it was no better than American lead that had some age.

In another place we shall have something further

to say about white lead, especially about some of its faults, for to correct these faults is a part of the paint mixer's work; to know what causes the faults is a part of his education. Some believe that the white lead made now is inferior to that produced years ago, but this is not true. In fact, some lead corroders have been making white lead for upwards of a century in this country, and making it just as they always made it. But the oil we use with it may not be as good as formerly.

We will now take up zinc white, or zinc oxide. For it is an oxide, not a carbonate like white lead. It is an axiom that all oxide pigments are more durable than carbonates. To prove this attention is called to oxide of iron paint, certainly a durable pigment. However, that point need not be discussed here. Zinc oxide paint is very stable, acid and gas resistant, but lacks elasticity, hence is apt to crack and peel. Being an artificial product, its composition varies. A cheap grade may contain some lead compounds, such as sulphates or oxides, and possibly zinc sulphate, the latter very objectionable, as it is liable to cause streaking of the paint after application, owing to its being soluble in water. Zinc oxide, however, is seldom adulterated. Yet there are differences of quality that one must look out for when selecting this pigment. The principal points of a good zinc oxide pigment are similar or even like those that we

have used in reference to white lead. It should have good color, white, it should be finely ground, it should be opaque, covering well, and should, finally, mix easily with thinners. If the sample looks rather blue, then blue has been added to hide the grayness of the zinc. Hence, if the zinc oxide looks blue, not pure white, reject it. Poor grades of zinc white lack opacity, they do not cover well. And if barytes has been added the fault will be worse for it. But let us note here that certain zinc pigments contain barium sulphate, as an essential ingredient. Barium sulphate differs from the native barytes in its physical properties, so that the presence of barium sulphate in a white zinc oxide paint is not evidence of adulteration; it is simply evidence that it forms a different paint, a zinc sulphide paint; sulphide zinc should contain not less than 30 per cent. of true zinc sulphide.

It is difficult to grind zinc oxide in oil, and it is not uncommon for the grinder to add some pale boiled oil, or a thickened boiled oil, to make the product appear smooth and finely ground. Take it and thin up with turpentine and apply some of it to a piece of clean glass, using a soft hair brush. Note the result.

You may find that thinning zinc white is more or less difficult, and that the paint will appear stringy and ropey. A good zinc oxide will be as easy to thin for using as white lead will. What the grinder should grind his zinc white in is refined linseed oil only. Zinc

paints should not be ground too stiff, as this is apt to cause overheating of the rollers of the mill, and we have already seen what that means. Burning the product means ruining it for paint purposes.

In the proper place we shall have much to say about zinc oxide paint, about its mixing and application. In the present chapter attention has been directed to the nature and properties of this useful and even indispensable pigment.

CHAPTER V

LINSEED OIL, ITS MANUFACTURE AND MERITS

The seeds from the lint or flax plant furnish us with an oil that, for painting purposes at least, no other known oil can rival. It is true that there are a few other vegetable oils that can be used in paint, but such oils are either impossible owing to impossibility to produce on a large scale, or too costly to be practicable. Nor does any commercial oil other than linseed oil possess the desired properties in a sufficiently high degree to make it a desirable substitute for the linseed oil.

No other oil that may be added to paint will give so hard, tough, elastic and durable a film as this peerless fluid. Certainly not in as brief a period after application of the paint. Raw linseed oil has good body, flows well under the brush, and spreads well. Its good body enables it to hold up the pigment incorporated with it, and gives a paint that is uniform of color and appearance; such a paint will not run nor become streaky. And after the paint has become dry the film will not crack or deteriorate in any way, provided the paint has been properly made and applied. The odor

of this oil is pleasant, its taste is agreeable, it withstands sun and weather well.

Just a word concerning the making of linseed oil. Formerly the seeds were crushed and ground to a pulp; then the mass was placed in a cold press and great pressure was brought to bear upon it, the oil running out into a vessel. Very simple, and excellent too. This oil contained very little mucilaginous matter, technically known as foots. It was quite light as to color, or pale, and it could be used at once if it was so desired. But all the oil in the seeds was not obtained; considerable remained, and the cake was sold for cattle feed. It is not likely that any cold-process linseed oil is being made. The area adapted to flax culture has become greatly circumscribed during the past few years; the ground best adapted to its culture is virgin soil, but virgin soil is hard to find now on this continent at least. Yet considerable flax is still being raised here, in the far west, or where land or soil is available. The very high price of flaxseed stimulates its culture on a large scale, within the restricted areas. Probably more is raised now than formerly, but then the demand has been and continues to be great, more so than production keeps pace with. Considerable seed is imported.

In order to extract the last vestige of oil in the seed heat must be employed, the ground seed is sort of cooked with steam, and this breaks up the plant cells

and liberates the oil, besides not a little of the gum also. You cannot use this oil soon as it comes from the press, for it contains water and gummy matter, and these must first be removed by filtering and storage in tanks, besides undergoing various other processes. By this time the oil is pretty free from all undesirable substances. But it should be stored quite a long time in order to produce a perfect oil. Good flaxseed is desirable in the making of the best oil, and all foreign seeds, of which there is usually too many, must be removed before crushing. It is here where careful manufacturing comes in; of which more follows.

Take raw linseed oil; it is the most used in house or structural painting. Raw oil is simply the oil as it comes from the press; it has not been altered excepting to remove its impurities. If you buy a barrel of this oil you will improve it by allowing it to remain in storage for some time. For there is always more or less foots in the oil, no matter how carefully it has been made. Age improves the oil by the separation of the foots from the oil, and when the oil containing foots is used in paint the film of paint will remain soft or tacky. The kind of seed used in making the oil has much to do with the amount of foots. Calcutta seed gives an oil freer of foots than the seed from America and Canada. This statement should be modified; at present we are making an oil quite as good as the oil from

the Calcutta seed, using the native grown seed, but not all oil is thus made.

Boiled oil is the raw oil with prepared driers and carefully boiled. The boiling alone would not result in the oil drying any sooner than the raw. Many painters think that the heat causes the oil to dry. It takes raw oil from 48 to 72 hours to dry, whereas the boiled oil will dry in from 7 to 12 hours, it is said by those competent to affirm. One thing the boiling surely does, and that is to set free all the mucilaginous matter in the oil, and that is very fine work. It you happen upon some alleged boiled oil and find foots in it, regard it with suspicion; it probably is bung-hole-boiled, or raw oil to which has been added a certain amount of driers.

There are several kinds of boiled oil made, to meet the needs of paint makers, varnish makers, and so on. Refined oil is that which has been bleached out, being of a pale yellowish-white color. It is used in making certain white paints. It dries slowly, hence must be assisted by the addition of driers. Such an oil will find scant room in the ordinary paint shop.

Linseed oil just now is a very costly paint ingredient. It never was so high in price before. For that reason linseed oil substitutes abound on the market, and oil adulteration is not uncommon. The principal adulterants are mineral oils. Rosin oil also is used, and is very useful when a petroleum or mineral oil is used; the lat-

ter are of lower gravity than flaxseed oil, and to remedy this defect rosin oil, of higher gravity, is added to increase the specific gravity of the made-up oil.

To do good painting you need to use pure linseed oil, as well as pure everything else that enters into the composition of the paint. But if you do not wish to do first-class work, then buy the ingredients and make your own dope; you will save money on it.

How shall you tell whether your oil is pure or not? In the first place buy from a reputable dealer. You won't get dope. Not though you ask for it. There is only one sure test, and that is up to the paint chemist. But there are several methods that anybody may use. First, there is the odor; no other oil has the odor that linseed oil has. Then there is the taste, which should be mild and sweetish. Then we have the so-called spot test. Spread some of the oil on a clean piece of window glass, then with a glass dropper take some strong sulphuric acid and let a drop of it fall on the center part of the oil. In pure oil the acid will not spread, but will burn a hole in the oil about one-fourth inch diameter. But if the oil is not pure, the acid will cause a bloom to appear on the oil around the spot, or very fine lines will radiate from the spot. There are many more really simple tests, but those given should answer the purpose.

CHAPTER VI

TURPENTINE AND OTHER PAINT THINNERS

As linseed oil surpasses all other oils for making an oil paint, so does spirits of turpentine excel all other fluids for thinning paint for interior uses. There was formerly just one form of turpentine spirits for the paint shop; now there are two kinds, though differing mainly in the source from whence the two are derived. One, the old-time spirits, is still made from the turpentine gum, the other being produced from the stumps and refuse wood of the trees that produced the gum. The first is known as gum spirits, the other as wood or stump spirits. Gum spirits thins out the paint satisfactorily, the paint does not act short under the brush, it assists the drying, prevents wrinkling, reduces the tendency of the paint to become fatty or oxidized, works all right even on wet wood, for it mixes with water. It is not affected by extreme cold, and mixes well with all other paint oils and thinning fluids. One of its most valuable merits is its flatting quality. When we desire to produce a flat or lusterless effect in interior painting there is no other fluid that will give as perfect a result. Benzine comes the nearest

to it, but paint works hard under a benzine thinner. It evaporates too rapidly. This is shown in the case of a varnish that has been made and thinned out with benzine; one can scarcely work his brush fast enough to get the varnish spread evenly. With turpentine it is different; while it also evaporates rather quickly, yet we are afforded ample time for doing a good job.

Wood or stump turpentine or wood spirit, variously named, has the same diluting power that gum turpentine has, and its specific gravity and flash point are identical. But the odor from wood turpentine, particularly that from knots and stumps, is very offensive, but this odor can be modified by redistilling, it is claimed. The redistilled spirit is water-white and is sold as pure commercial turpentine. The dry-distilled product has a very strong, pungent odor, and if kept in the dark for some time becomes deep yellow in color. The steam-distilled product has less odor than the dry distilled, is water white, and does not turn yellow so soon. It is quite satisfactory in place of the gum spirit.

Owing to the growing scarcity of the timber from which turpentine comes this fluid has become very costly, and hence substitutes are in the field, with more or less recognition. The test for turpentine is simple enough, just pour a few drops on to a piece of white paper and let it remain some time before looking at it. Pure turpentine spirits will evaporate entirely,

leaving the paper white as before; you will not be able to tell where the grease spot was. And this test may be without loss of time, while you are mixing up some paint. Even when some of it is placed in a saucer it will evaporate entirely, leaving no trace that can be perceived.

Judged by odor alone some of these substitutes will deceive you. Naphtha of a particular grade is used as the base in most of the substitutes; it is a water-white liquid, grading somewhere between kerosene oil and benzine; it is less oily than the former, and less volatile than the latter. To "improve" it the addition of some wood turpentine is practised by its manufacturers, with a little pine oil and rosin spirit; by that time the product smells very like the real thing. Often, however, the pure petroleum distillate is sold as substitute. But this does not mix as well with paint or varnish as the "improved" fluid does, nor does it have a turpentine odor. There are different methods or formulas for making the substitutes; we have given one, and another is this: Equal parts of benzoline and rosin spirit and twice as much of turpentine. What is called Russian turpentine is a substitute based on Russian petroleum distillate, the Russian oil being greasier than the American, hence not so good for use in a substitute turpentine, nor for producing a lamp oil or kerosene.

If you should come across the term, Camphorated

Turpentine, know that it is simply real turpentine to which has been added some gum camphor, making a liquid that is useful in shellac varnish, to make it less brittle, also for use in enamel work on wood.

Benzine is useful in the paint shop, but cannot take the place of turpentine. During the Civil War deodorized benzine was used in the absence of turpentine, but first-class painting, where a flat effect is desired, cannot be achieved with benzine. It does not leave a dead surface on the flatted paint; it leaves a slight gloss, according to the amount of oil in the paint. Also white paint flatted with it will turn yellow in time. There are objections to benzine as a paint and varnish diluent. It does not do well on wood containing some moisture, for it will not mix with water. Owing to a high rate of evaporation it will not do in japanning and baking. If it is cold, near to the freezing point, and is added to varnish to thin it, it will cause precipitation of the gums in the varnish. Thus it will be seen that benzine is not adapted to either a hot or cold condition.

What, then, is benzine useful for in the paint shop? If you simply wish to thin out a paint benzine will do it even better than turpentine, and it will do the paint no harm. It will evaporate entirely. Or, should you wish to make enamel paint flow and spread easier, benzine is the fluid. Turpentine would do it but it would not evaporate as benzine does, and the result

would be a thinner coating of the enamel paint than you desired; benzine would leave the coating as it found it. Benzine would not impair the gloss of the enamel finish; turpentine would.

Benzine is a great solvent of oils; hence when used to thin out a paint it renders the paint soft after it has dried. Turpentine tends to make the paint film harder.

Benzol or benzole belongs to the benzene class, and is a product of gas tar. There are two grades, one known as the 90 per cent. benzol, the other as the 50 per cent. benzol. They differ in their chemical composition, and for our use we would take the 90 per cent. fluid. Solvent naphtha is another name for benzol. It is water-white, volatile, and a perfect solvent for oils, fats, rubber, gum resins, etc. With acetone it forms a paint and varnish remover. Like turpentine it leaves no stain on paper nor residue after evaporation. It is very inflammable, hence must not be used in the presence of fire. It mixes freely with turpentine, benzine and linseed oil. Very frequently it may be used in place of turpentine. It is a satisfactory thinner for paint and varnish. But should not be used in paint excepting in the priming coat. It is a perfect solvent of rosin, hence in paints containing rosin oil it will prevent the granulation of the rosin.

Kerosene or coal oil should never be used in paint, but it will give elasticity to varnish used in baking

enamelled objects, and also to paint, but it is not advised excepting in some rare cases, as where you find the enamel paint brushing out hard a little coal oil will cause it to flow out easily and freely. It is a non-drying oil, though with plenty of good manganese driers a paint thinned with it can be made to dry satisfactorily. Painting on damp wood with such a paint, drying would be impossible where the wood and paint came in contact. As all hydrocarbon oils evaporate, kerosene is no exception; in process of time 85 per cent. of it will evaporate.

We have another peculiar thinning agent for paints and oils in tetrachloride or carbon tetrachloride. It is a good solvent, varnish makers finding it very useful in this respect. It will dissolve anything that benzine, turpentine and benzol will dissolve, some things that dissolve with difficulty in other solvents readily yield to this one. One of its most important features is that it is non-inflammable; you cannot set it afire. However, as a paint or varnish thinner it is too costly. It should be added that it is used in cleaning clothing, removing stains.

We mentioned rosin oil. There is a rosin spirit, produced by the distillation of rosin. It is a solvent and thinner of paint or varnish, but its odor is bad and it has a poor color. Gloss oil or rosin oil is not an oil at all, but a thin sort of varnish, made from rosin dissolved in benzine. It has little body, and sets very

rapidly, though this can be retarded by the addition of some petroleum spirit.

Pine oil is distilled from pine and fir seeds, though oftener, especially as a commercial article, from pine wood and pitch. Its color is pale yellow and its odor is like dry distilled turpentine.

Alcohol is most used for dissolving gum shellac. The best is that made from grain. Wood alcohol is distilled from wood. The former is ethyl and the latter methyl alcohol. Wood alcohol is not safe to use in the painting trades. Denatured alcohol, which is simply grain alcohol containing ten per cent. of wood alcohol, so that it will not be used as a beverage, is safe and as efficient as the pure grain article.

It will be useful to know how to distinguish the different solvents that have been named in this chapter. Each has its own peculiar characteristic and this enables us to distinguish them apart when we meet them. Pure spirits of turpentine has a pine odor that is rather mild and not at all offensive, and once used to it we are always able to tell it from its closest imitation. Wood turpentine has the pitch-pine smell, but in greater degree, the odor is rank and very offensive, so much so that most people will not allow a painter to use it in their house. Benzol has a coal tar odor that is offensive. Carbon tetrachloride smells like chloroform; both are non-inflammable. Coal oil or kerosene oil leaves a greasy spot on white

paper, and its odor is familiar and unlike any other petroleum product. Benzene has its own odor, and will hardly be mistaken for some other white thinning fluid.

Efforts have been made to produce an oil to take the place of linseed oil, to some extent at least. We will describe the chief of these. They are still talking up soya bean oil as a paint oil. It can be used with linseed oil, but alone in paint it is not satisfactory. It is not a good drier, and a paint film produced by it will be lacking in toughness, being incapable of taking up oxygen from the air to the necessary extent.

Cotton seed oil has been tried. It will not do. It is a non-drying oil. Even a very small quantity of it in paint will retard drying and give a sticky paint film.

When corn oil was quite cheap there was some talk of it as a paint thinner; some paint and putty makers tried it, and without success. It is a slow drier and has a bad odor.

Fish oil, produced by the menhaden fish, has one point at least in its favor, for it is useful in mixing paint for smoke stacks or other parts subject to considerable heat. There are three grades of fish oil, crude, brown and bleached. The brown oil is sometimes used in grinding dark paints, but the bleached oil is better, as it has less fish odor and can be used in light colored paints. Some experts regard fish oil as the best substitute for linseed oil that we have. It

dries about as well as linseed oil, and in paint forms a hard, waterproof film.

China wood oil or, as it is known in China, Tung oil, has been used by the Chinese for centuries, for lacquering and waterproofing their river craft. It is a very peculiar oil, and so far our paint and varnish makers do not seem to have been able to adapt it successfully to the making of varnish or paint. Its greatest value would seem to lie in the direction of varnish making, as its very heavy body does not adapt it well for paint. It has its peculiarities. It dries more rapidly in wet weather than in dry. It dries very hard. One reason why it will not do in oil paint is that it causes the paint to dry flat, and where paint is used on exterior surfaces such flat finish would not be desirable. When used in varnish it renders the varnish immune to acids, hot water, etc. But as yet such varnish has not been made to any extent. Much more might be told about this interesting oil, but this brief account must do.

There are other oils, such as poppyseed and hempseed oil, that are good paint oils, and are used as such, but not in general painting; artists are the principal users, though poppyseed oil is useful and practicable for grinding zinc white in. There is also sunflower seed oil, which has some good points recommending it to the painter. However, linseed still continues to be our main reliance.

CHAPTER VII

DRYING AGENTS USED IN MIXING PAINTS

Given a fair understanding of the drying qualities of the pigments and liquids used in producing mixed paints the painter will use specially made drying agents in a conservative manner. He will know that under certain conditions the paint will not require the assistance in drying that driers afford. That in some cases a very small quantity will answer the purpose, while in other cases it will be necessary to use a larger quantity. Some of the pigments that he will use have a great influence upon the drying quality of a paint. Others have little or no influence, while some retard the drying. It is very important to know these things.

What is a drier? As you take down the can containing driers you see printed on the label, Driers, or perhaps Drying Japan, or still, perhaps, the label will contain some trade name, indicating a certain brand. There are two forms of paint drier, one made from linseed oil and some form of drying salts, such as salts of lead, or of manganese or cobalt. The other is made by substituting rosin for oil. The linseed oil or turpentine japan drier are to be preferred. Lin-

seed oil drier, after it has been boiled, has turpentine, or that and benzine added, to thin it out with. The turpentine drier is better than that containing some benzine. Turpentine adds to the drying quality of the drier, but benzine does not.

In adding driers to mixed paint the tendency is to use far too much. It is a matter of hit or miss with most painters; mere guess-work. This is bad for the paint and for the reputation of the painter. There should be taken into consideration, when mixing paints, particularly for exterior use, the state of the weather, the climate, the season of year, and the kind of oil and pigment you are to use in compounding the paint. Temperature and humidity have a good deal to do with the drying of the paint. Humidity seems to have less influence than temperature. The higher the temperature the more rapid the drying. The lower the temperature the slower the drying. Paint dries better in summer than in winter, better in warm weather than in cold. And of course paint will dry somewhat better in dry than in wet weather. Then, there is the influence of the oil, base, and pigment. Linseed oil is a good self-drier, though of itself it will require two or three days to dry, hence needs assistance. White lead dries well, and yet needs a little help too. As to the pigments, some assist in drying very materially, umber being a good example of this class. On the other hand, there is lampblack, a very

poor drier, no drier at all when not mixed with some drying agent, such as linseed oil, etc. And even when mixed in linseed oil it dries very poorly, or not at all; here it is necessary to use driers liberally, in order to get the black dry in anything like a reasonable time. By adding some Prussian blue to it the drying will be hastened. The blue will at the same time increase the apparent blackness of the lampblack. When umber is used in coloring a lead paint a very little amount of driers will be required, for umber is a strong drier itself. Chrome yellow is a good drier. So also Prussian blue. Vandyke brown and sienna are poor driers. Ochre needs driers, as it does not dry of itself. It seems that such poor drying pigments as lampblack and yellow ochre have a decided influence on linseed oil, or on the absorption of oxygen by the oil, and this is hard to understand, because those pigments have no chemical effect at all on the oil. As the chemist would say, it is an exceedingly complex, and in some ways, an abstruse subject. All we know for sure is the simple fact, and all we can do is to use a good drier when using these pigments in paint making.

Paradox though it may seem, when we add too much driers to a paint the effect is to hinder the drying process. One might suppose that if some would do good, more would do more good, but it doesn't. And the chemist explains the matter by saying that

if oxygen is absorbed too rapidly by the paint film a secondary chemical action takes place which prevents the normal formation of linoxin, and these actions result in a sticky, non-drying product. A precisely analogous phenomenon is observed when linseed oil is exposed to the air in bulk, the familiar substance known as oil gold-size being produced in this way. And oil gold-size is simply fat oil, so called, and which forms on the top of mixed oil paint that has been left to stand in the pot for some time.

But let it be observed too that some driers are not efficient starters of the drying process, but once drying has started they do their work well. New linseed oil, or oil containing much foots or albuminous matter, is apt to interfere with the proper drying of the paint. It may even entirely prevent the drying of the paint to a suitable hardness. Inasmuch as driers are used in very small quantities, it would seem well to purchase the very best. That is at least the only way to insure good results in the drying of an oil paint. It is considered a good drier that will dry raw oil at the rate of 1 to 20; one part of the drier to twenty parts of the oil. Such test should be made under average normal conditions. The oil should be dry to the touch in 12 hours. Now, if you have such a standard drier, and some manufacturers claim this strength for their particular brands, it is easy to add just the proper amount to the paint, instead of guessing.

If you do not care to take the maker's word for it you can test the driers for strength or drying power. Take one fluid ounce of the drier and add it to one quart of raw linseed oil; stir together well, then flow some of it on to a piece of clean glass, hold the glass upright, set it that way in a secure place, then note how long it takes in drying. But it is useless to try the drier by itself on the glass, as that would be no criterion as there is a certain drier, made for factory use, that is a strong drier of oil, yet will not dry of itself in many hours.

It may be supposed that a cheap drier will be economical, as compared with a high grade and costlier one, but this is not so, as it may take much more of the cheap drier to do the same work that the best drier does.

Here is a simple test for driers. Attach a sheet of white paper to a piece of clear glass and lay the glass on a table. Place a little raw oil on the glass, and in the midst of the oil drop a very small amount of the drier. Incline the glass a trifle as the japan touches the oil, and watch the action of the drier. A good drier will unite at once with the oil; otherwise the drier is poor. Then stir the two together with a pin or other small article, and see whether the drier curdles the oil. A good drier will not curdle the oil. Another simple test is to place some driers on glass and let it dry for 36 hours, or until it is

quite dry. Then scratch it with a knife or the finger nail. If it comes off easily in scales, it is poor. If it seems gummy, it indicates a slow but sure drier, but one that is not very strong. If the drier shows fine cracks on the glass after drying hard it is too brittle. The odor of a drier is not a test, only that when it smells of benzine it is not a first-class article, a good drier giving the odor of turpentine. Color has something to do with a drier's drying quality; that is, a drier that is pale or very light in color, sometimes called white driers, is not as strong as a darker drier, because the more a drier is cooked in the making the stronger it is, and also the darker. The increased heat darkens a drier. For exterior paint an oil drier is best, one that does not contain any gums, rosin, etc., which cause cracking of the paint, not being elastic enough. For quick drying of paint you need what is called japan driers; flat or semi-flat paint should have a quick drier.

Paste or patent driers consist of a base, usually barytes and white lead, with zinc sulphate and lead acetate, made to a paste with boiled linseed oil. This form of drier is intended for fine white painting, interior. A formula for making this drier follows: Mix to a paste two parts each of pure white lead or zinc white, zinc sulphate and lead acetate (sugar of lead). This form of drier may be used with dark paint, but in this case replace the white lead with barytes or terra alba.

It will be worth while now to take up the methods of making the various forms of paint drying liquids, for the more we know about their composition the better fitted we shall be to use the liquids.

The term "lightning drier" means that it is an unusually rapid drier of paint. It is not fit to use in exterior paint. It is cheap as regards selling price, but not economical, excepting for uses outside of house painting. One kind, made with gums, dried in 30 minutes; one made without gums dried in two hours. The samples were tested on glass. They were benzine mixtures.

Litharge drier is very powerful, and red lead is even more so. Both need to be used sparingly as driers, about 4 parts to 4000 parts of oil. Years ago litharge was the only drying agent used in colored paint; for white or light tints the patent drier mentioned was used.

There are many factory formulas for making driers, as may be supposed, each maker having his own favorite process, though in the main all may be very much alike. That is to say, the different grades may be similar, proportions of ingredients and the ingredients themselves may vary a little. Quite a number of substances may be used, as the following list will show; Gum shellac, litharge, burnt umber, red lead, lead acetate, raw umber, zinc sulphate, Kauri gum, rosin, black and red manganese oxides, lime, borate of

manganese; and of liquids, linseed oil, turpentine, benzine, and petroleum oil.

Manganese is a good drier and is much used in making driers and drying-oils. A strange quality of this mineral must be noted here; when it has been used once in the making of drying oil, which means raw oil and manganese boiled together, and is used for another batch of oil, it proves stronger than when first used. I do not know why. Manganese is apt to give white paint a pinkish cast, hence it is best to use a combination of lead and manganese.

While turpentine is considered the best liquid in connection with linseed oil in the making of a paint drier, yet the Government does not require it in their specifications for navy work. They require a high-grade hydrocarbon thinner, and it appears that no difference can be perceived between the turpentine and hydrocarbon (petroleum product) thinners. But they will reject any driers containing rosin. Our Government is very careful in its specifications for driers.

CHAPTER VIII

PAINT MIXING, INTERIOR AND EXTERIOR

Paint for structural work may be divided in two classes, that for interior use, and that for exterior use. While interior paint is seldom or never used for outside work, exterior paint is often used for interior work. Where interior work is to be done in white it is necessary to use a white base thinned with turpentine, or as in some cases, with both oil and turpentine, the proportion of oil depending on the character of the work. The reason for this is, that turpentine preserves the white color of the paint, oil causing white paint, particularly on inside work, to yellow with age. This does not occur with white paint used on exterior work, for there the sun and air bleach the oil and the white paint usually becomes whiter with age. But when it is desired to use a colored paint on interior work an oil-thinned paint, with just a little turpentine to harden it, may be used, for it will not yellow on account of the darker color of the paint hiding any color change of the oil. Of course colored inside paint may be thinned with all turpentine, as white paint is, if a flat finish is desired.

We will take up the mixing of paint for exterior

work, remembering that the term exterior paint embraces quite a variety of mixtures, each having a specific use, a use that no other particular mixture can replace, not as a rule at any rate, and it is always best to compound a paint with a view to its adaptation to the work in hand. Thus, the paint intended for a metal roof could also be used in painting certain other kinds of work, but not so well. It is often urged against ready mixed or so-called store paints that they are intended to be used for several kinds of work equally well, and the claim is not a sound one. Taking, say a new building, and there will be the first or priming coat, consisting of white lead made quite thin with oil; white or colored. Now, to say that a thinned out ready mixed paint will answer for this priming coat is not tenable. First, it will contain too much driers, and a priming coat on wood, particularly on wood having a rather hard surface, should contain little driers, which tend to obstruct the sinking in of the paint, by causing it to begin drying too soon. Ready made paints usually contain much driers, more than is good for the paint. This because the paint is supposed to meet with various climatic conditions and to be used in the different seasons, winter and summer, spring and fall, wet and dry weather, hot and cold. It is obvious that too much driers will cause a paint to burn out in hot weather or in warm climates. And in such cases very little driers are required, in some instances

none at all. But in order to meet different conditions, dampness or cold, the excess of driers meets the case well.

In former days there was but one kind of wood used in building, select white pine. This is an ideal wood for the purpose, taking paint well and not doing the paint any subsequent injury, as some other woods do. To-day we have many kinds of wood to deal with in painting. And not one of them ideal either; far from it. It makes the preparation of paint a difficult problem, each wood requiring its own particular kind of paint. But this matter will be taken up in another place.

To mix a pot of paint seems a simple operation, and it is when you know how, but as in all other forms of mechanical work there is a right and wrong way to do it. First we shall have to open up the keg of lead. When lead came in wooden containers much of the lead's oil had been absorbed by the wood, and this was considered to improve the lead. If the keg had been in stock for a long time the lead would be quite hard. Now that lead is put up in metal containers all the oil remains, not in the lead, unless fresh, but on top, and this can be removed if so desired. To prevent the formation of dried lead on the top, and which will form even though the oil is there, the lead makers place a disk of thick tough paper there, and this very nearly prevents all such dry lead. What is left should be carefully lifted out into another

vessel so that the paint you are to mix may be clear of lumps and bits of dry lead. Now, before taking out any lead and placing it in your paint pot, first take a paddle and press the lead away from around the sides of the keg, and so work the whole into a smooth plastic compound; then remove what you need of it into the paint pot, scrape and clean down the sides of the lead can and carefully smooth over the top of the lead, and a little oil on top of that, with replacing of the paper disk, will leave the lead in nice shape for the next time. About eight pounds of lead will suffice for making a pot of ordinary paint; but, as the primer is thin, half of that quantity may do. But this is not important, the usual practise being to place into the pot about what you think will suffice, without weighing. A beginner, however, would find it more satisfactory to weigh out the lead and measure oil and thinners generally. It should be said here that before placing lead in the paint pot it would be better to put a little oil in it, so that the lead will not adhere to the bottom, making it more difficult to mix. To thin up the lead add a little oil and mix with the paint paddle to a smooth, buttery mass; then add some more oil, stir as before, and so on until you get the lead sufficiently smooth and thinned. If you are going to use the paint as soon as mixed, add some driers, say a tablespoonful to the pot of paint. The amount of driers will depend upon the

weather, the kind and condition of the wood or surface to be painted, and also upon what colors you incorporate with the paint. Having adopted a certain good brand of driers you will in time get to know just how strong it is and how much to use.

If the paint is not to be used at once, or for some time, then omit the driers, which will tend to make the paint more or less fatty, according to the time it stands before using. Fatty paint means that the oil has become more or less oxidized, and in this condition paint is apt to blister under exposure to the sun. It is a non-drying oil varnish, in fact. Another item, the paint will improve if kept two or three days before using; it becomes ripened, if we may be allowed to so call it. It wears better than fresh made paint, and seems to go farther and spread better under the brush.

If the paint is to be colored, then add color while the lead is in the stiff paste form, after you have stirred it to that condition. The reason for this is, that the color is usually lighter in gravity than lead, and hence would bob around on top of the mixed lead, like a cork, and so prove a bother. Lampblack is particularly bad in this respect. But when the color is added to the stiff batter of lead the lead serves in facilitating the mixing. Some colors would be better to be mixed separately, either in some of the lead paint, or in turpentine, depending upon the kind of pigment, before adding to the white lead.

Metal paint paddles are now made, with perforations in them, but there is nothing better than the hand-made wooden paddle. This should be made of soft wood, white pine being ideal, about four inches thick, about 17 inches long, two and one-half inches wide at the mixing end, and about an inch at the handle end. The edges should be rounded off, and the broad end chiseled. Several of these paddles should be kept on hand, as it is better than having one for mixing all kinds or colors of paint.

All paint is the better for being strained after mixing; doubled cheesecloth, say a small salt bag, will do, though a paint strainer with copper strainer is useful. The cheesecloth will strain the paint finer than the wire strainer will. Stretch it across the paint pot, using a piece of twine or string, and when done with it place it in a can of water, for the next time. Have one cloth for colored paint, another for white and very light tints. To assist the paint through the strainer use a sash tool or other small stiff brush, and remove strainings with a putty knife, into a small can set beside the straining outfit. Save these strainings for future use, which will be described later.

There is advantages in straining the paint, whether it is to be used indoors or outdoors. Whether for fine or common work. First, it spreads easier under the brush. Next, it makes a better looking job. Again, especially if you are doing an inside job and good

work, it will save time by your not having to stop to pick off specs or nibs of lead, etc. Moreover, the strainer will catch and your brush used in the straining will crush any chance bit of color, which if left in the paint would cause a streak that would require working out with the brush, with a chance of its marring the appearance of the finish. There are many such little things connected with painting that are worth while to know and to observe.

It may not be necessary to urge cleanliness in the paint shop, clean pots and brushes, yet a word may not be amiss. After you are done with the paint pot for the day, wipe it down on the inside with your brushes, and with a rag wipe off the outside. This is done in all first-class shops. In warm weather the paint dries to the pot very rapidly, and hence it is well then to wipe down the pot frequently, particularly when you are using turpentine paint, or outside paint with too much driers in it. In course of time the paint pot will be more or less incrusted with paint on its outside, and inside too; then it should be made clean again. There are two principal methods for doing this; one way is to burn the paint off, by filling the pot with paper and setting fire to it. Maybe a little coal oil on the paper will be better for a very thickly coated pot. The heat will soften up the paint inside and out, and while it is doing this scrape the old stuff down with a putty knife, doing the inside first. The

old paint will burn and thus assist in keeping up the fire. When all inside paint has been scraped down empty the fire and scrape off the outer side of the pot. You will then have a clean pot. The other way is to let the pot soak for some time in strong lye water, using concentrated lye, placed in a half-barrel. The latter method is used mainly by vehicle painters, who use a number of very small cans in their work, and practically no large pots. I like the fire method best. It is efficient, cheap, and can be done at any time.

Many painters add some turpentine to all outside paint, saying it facilitates penetration in priming-paint, and tends to harden the other coats. In winter it keeps the paint more normal as to working consistency, the cold not affecting it, while cold thickens linseed oil. The turpentine thereby makes brushing out easier in cold weather. But its use is common in warm weather for the same reason that it tends to harden the paint and thus form a tougher film.

For priming exterior work add one pint of turpentine to one gallon of raw linseed oil, and mix with from four to six pounds of white lead. Add driers, say an ounce to the gallon of oil. One ounce of powdered litharge also may be used, in place of the driers. Mix, strain, and rub well into the wood. For second coat thin the white lead with equal parts of oil and turpentine, omitting the driers. If the temperature is below 60 deg. Fahr., make the paint to weigh 16

lbs. to the gallon. If above this degree, let the paint weigh 18 lbs. to the gallon. The third coat may be prepared with all oil, no turpentine, or just a little, to give a harder film.

To mix paint for priming white pine add 20 per cent. of turpentine to 80 per cent. of oil. For priming almost any soft wood there will be needed a paint that is elastic and that has good penetrating power. For redwood it will be best to add benzol to the priming coat, for it is better than turpentine in this case; it softens the gum that may be present, and thereby enables the paint to penetrate better. Or you may use turpentine in addition to the benzol. Say 70 per cent. raw oil, 20 per cent. benzol and 10 per cent. turpentine. In using benzol in paint do not add it until you are ready to use the paint, on account of its volatile nature. Some use benzine in place of the above two liquids, but there does not appear to be any advantage in doing so.

Cypress is another wood that needs a high penetrating liquid, and a pint of turpentine or benzol to the gallon of primer will do. This wood is to be primed as soon as possible, to keep down the planer marks, and which rise under the influence of the weather. Paint, the priming, dries very slowly on some parts of it, and no amount of driers appears to make it dry any faster. Where the same paint would dry over night on white pine it would take several

days to dry on these certain sappy parts of cypress, and hence a coating of shellac would seem to be the only remedy. Or a coating of benzol would help. Some painters apply a coat of japan driers. This would do very well in place of the more expensive shellac varnish. Primer for this wood should be quite thin and be mixed from lead and thinned with turpentine or benzol or equal parts of both 80 per cent., and of oil 20 per cent. If the primer is thinned with oil only there will be dry and wet streaks. Another plan consists in burning the surface with a torch, to kill the sappy streaks. A paint made from red lead and white lead is a good composition for the first coat. The English painter adds red lead to much of the priming paint that he uses, and we too might use it oftener than we do. It is a good drier, and makes a harder paint than white lead and oil. For first-coating any wood it is to be recommended.

Yellow pine is a difficult wood to paint, owing to its gummy nature. In describing how to mix paints we must of course describe the surfaces that are to be painted, there being no such thing as a universal primer. To successfully paint hard or yellow pine was for some time a problem, then some Southern painter hit upon adding a little pine tar to the priming coat, which consisted of white lead thinned very thin with a little oil but mostly turpentine. And now benzol is used in place of turpentine. It is claimed

that when wood tar is added to the priming coat there is no subsequent trouble with paint on hard pine. As a general thing paint dries slowly on this wood. The succeeding coats, and there ought to be at least three, should be rather thin, well rubbed out. Heavy coats are apt to peel.

Oregon and Idaho pine will take rather more oil than our Southern pine, yet plenty of benzol or turpentine will not be amiss. The surfaces of these woods are uneven, not like southern hard pine, hence in drying there will be soft and hard parts, dry and undry.

Poplar and cottonwood are in some respects like white pine, easy to paint and paint dries well on both. But two-coat work does not do as well as it would on white pine. In fact, three-coat work is best on the best of woods.

Spruce is used in structural work, particularly for weatherboarding. This wood should not be painted until it has stood to the weather for some time, a month at least. It is a hard kind of wood, and the primer should have benzol or turpentine as a thinning agent. An expert advises that water be added to the priming coat, his theory being that the water will open up the sealed pores of the wood and allow the paint to enter, after which the water will dry out and no harm done.

The best base for a priming paint is white lead ground in oil; zinc white will not do. A little red

lead added to the white lead is advised. Driers should be used in moderation; in some cases none need be used. Do not use boiled oil in the priming paint, it is too thick and is a drier. If red lead is desired to add to the white lead, use the dry; dry red is of fine texture, and does not require grinding to make it finer. When you have some old work to prime, where the old paint has been removed, a priming of red and white lead is the best to use. If the wood is very dry it would be well to size it first with raw oil, which when dry may be painted over with the primer. Don't mix your primer too heavy, for that will cause brush marks that will have to be sandpapered out, or if left will mar the finish. Never use ochre for priming. A partly worn brush will do better work than a new brush. It may be an advantage to add a little color to the primer when the finish is to be in color. This is particularly good where the wood is unevenly colored naturally, as it presents a solid appearing surface. By making each successive coat a trifle darker you will see better whether you have missed any parts.

In another place I spoke of the inadequacy of ready mixed paint as a priming paint, when thinned up. I should have added to what I said there that the objection might not with justice be applied to the best grades, which come nearer to hand-mixed paint. The trouble with the inferior, or even with the aver-

age fair grade, of ready made is that they are composed of pigments and bases that will not stand thinning. Here for example is a paint composed of white lead 56 parts, barytes 28 parts, iron oxide 10 parts, and lead sulphate 6 parts. And this paint was thinned with adulterated oil and turpentine. Thin this down to priming paint consistency and you have no body at all.

One of the most difficult jobs is an old frame building, whose weatherboards and other exposed woodwork has not been painted for a number of years. If the old paint has left it entirely the case is not quite so serious; but if it presents patches of old paint it is troublesome: But the trouble is greatly enhanced if there is a great deal of the old paint remaining, with bare spots only here and there. There is too much old stuff to remove in the latter case, and how to retain it and get a good finish is the problem. To remove a great amount of old paint means time and labor, which is usually enough to forbid the work. Either fire or strong lye must be used to remove the paint, as commercial removers would be too costly. Fire is dangerous, lye is troublesome and involves a lot of work. But let us suppose that the old paint has left the wood entirely. Then we have a surface similar to new wood, in that it is bare, though otherwise it is quite different. The wood is very porous, like a sponge, the painter would say, hence ordinary

thin priming will not do. Here is a good formula to meet the case: Take say 20 lbs. of bolted whiting and mix it to a paste with equal parts of water and turpentine (benzine is really called for in this formula, but as that fluid has no affinity for water and turpentine has, I prefer the latter; of course it is the costliest of the two). Then mix up 50 lbs. of white lead, ground in oil, and beat this intimately into the mass. Then thin to the proper brushing consistency with equal parts of raw linseed oil and sweet milk. In adding milk pour in a very little at a time, and stir briskly; water or milk is not difficult to mix with the above paint. Finally stir the mass well, and it is ready to apply. Brush it out evenly. This paint is designed to fill the open-pored surface, thus saving in the use of all-lead paint, and in its cost; besides which it requires a sort of filler to make such a surface solid for the next coat of paint. And the next coat may be straight white lead and oil paint. Driers are to be added to the filler coat as described, as well as to any succeeding coats.

Referring again to the matter of using a little turpentine in our exterior paint, it is used for another reason; usually we like to have a good gloss on the finish coat, exterior work, and to get this in its best form it is necessary to make the coat beneath it somewhat flat or without much luster; for it is a rule that where you desire a gloss the under coat must be

without gloss; and to produce the best flat effect it is best to have the under coat more or less glossy. If in painting in oil color you happen to apply a full oil paint on top of the same kind of paint the result will be a partly flatted finish, neither one thing or the other. Again, in winter a little turpentine keeps the oil paint from crawling, a fault caused by the cold. And wrinkling that sometimes occurs may be prevented by the use of a little turpentine in the oil paint. So that turps, as painters call it, for short, has its use even in outside paint.

Paint for winter use, exterior, must be made different to that intended for summer use. The oil thickens by the extreme cold, and the paint becomes like mush. It would be a mistake to thin it with either oil or turpentine, as that would simply reduce its body, and the coating would suffer in consequence. The proper thing to do is to place the paint indoors where there is enough heat to warm it to the right consistency. This warming would have to be repeated as required, though it is seldom required at all. I have painted outdoors in the severest winter weather, and never yet warmed the paint. The intention here is simply to warn you not to thin with a liquid. The best plan is to add enough turpentine when mixing the paint to keep it fluid enough to spread nearly normally. Then paint in winter time needs more brushing out, on account of being rather stiff.

Some use genuine kettle boiled oil for winter paint, and in this case I would advise the addition of a little driers, say a gill to the hundred weight of lead; the oil is a drier itself, but it will be well to assist it a little. For old work and where raw oil is used in mixing the paint it is advised to use one pint of the best turpentine japan drier to the hundred weight of lead. This for both priming coat and second coat. For new outside work use three half-pints of drier to the hundred weight of lead. These allowances are liberal.

Another paint problem is found in the matter of painting over a burnt-off surface. Such a surface does not take paint well, or does not retain it well. The paint for this condition is to be made very thin, at the rate of about 6½ gallons of raw oil and one gallon of turpentine to the 100 pounds of lead. This must be well brushed in, and the oil must penetrate well. The second coat may be made upon the formula of 5 gallons of oil and ½ gallon of turpentine to the 100 pounds of lead. The third and finish coat should be made from about 4 gallons of raw oil, and one quart of turpentine to the 100 pounds of lead.

What painters call "stock paint" is simply a lead paste made ready a day or two before for thinning up when wanted for application. Weigh out or take by guess the amount of lead that will do the work in view, and with the mixing paddle work it smooth

and free of lumps. The usual directions specify that driers are then to be added, but this I do not consider good practice, unless perhaps the mixture is to be used the next day; as a rule the driers is best mixed with the paste paint before thinning it. After having mixed the lead as directed pass it through a rather coarse mesh strainer, into a clean vessel, then cover it up tight to exclude air and dirt. Another way to get stock paint, which is called stock white by the painter, is to have it prepared at the paint factory, and this is only done in case a large quantity is used, as with the large contracting painters. And it is not unusual to have some other pigment than white lead incorporated, as many master painters believe that paint of exterior use is improved by adding to it as indicated. The addition of a certain proportion of zinc white is intended to make the paint film harder, not so likely to flour, as some white lead does. And some favor adding a proportion of barytes, which has as its mission the making of the paint more porous, a statement that we need not discuss here. Given this or any stock white, the contractor saves in the time it would take for the shop man to mix up large amounts of lead, etc. And it is always in stock, ready when called upon. By getting this stock white in rather large amount its cost is very little more than the lead in the kegs.

Ready mixed paints put out by paint makers must

be accorded space here. Many will doubtless use these paints, as many already do. As full directions are on the cans little need be said here on that score. But there are ready made paste paints also, white and colored. The thinning of such paints will depend upon conditions, etc., as with hand-mixed paint. There are general rules applying to the thinning of paste paints that may be given here. If the paste is to be thinned for priming new wood you may add from 25 to 50 per cent. of raw oil. For average exterior work 25 lbs. of the paste paint will take about five quarts of raw oil and a gill of good driers. This will give about two gallons of mixed paint, and will weigh about 17 lbs. to the gallon. For 25 lbs. of white that contains other base than white lead, use the same quantities of oil and driers as given in the previous formula, but it will give about a pint more paint and will weigh only about 16¼ lbs. to the gallon. For 25 lbs. of pure white zinc oxide add to the above formula 1⅝ gallons of raw oil and ½ pint of best driers. This will give nearly three gallons of paint weighing 13¼ lbs. to the gallon. Zinc white takes more oil than lead does, and when mixing it for exterior use do not add any turpentine, use only oil, the pale boiled oil for a white job. And such paint is to be applied different to white lead paint, being applied in what is called full round coats, much more so than lead paint, because zinc white has less body than

lead. Zinc white too is hard to dry, not being a self-drier, and hence if you should use the common commercial boiled oil, which may not be boiled oil, the paint will not dry satisfactorily. To mix white zinc paint with oil have ready two clean paint pots. In one put what zinc white you will require, say about 7 lbs., and gradually add and paddle in the oil until it has come to a paste form; then add the driers, stirring it in well. Then strain through cheese-cloth into the other vessel. Be careful not to get the paint too thin; it should be rather stout or full. If a mixture of lead and zinc is to be prepared do not add the zinc to the lead at once, but mix up each separately, and when each has been sufficiently thinned add the two together and stir until perfectly amalgamated. The reason for this is, the zinc and lead have different specific gravities, the lead being denser than the zinc. So that when we mix the two together right out of their kegs it is difficult to get the two to come together easily. We save time and work by mixing them separately. Many painters do not know this, and have trouble when they make up a lead and zinc paint.

CHAPTER IX

PREPARATION OF PAINTS FOR VARIOUS PURPOSES

It is a fortunate circumstance that the painter is free to mix his paint as conditions seem to require, and not have to use a ready-made paint that cannot well be made suitable for the various conditions that confront a painter when he has a job to do. Even a standard set of formulas are no more than guides, indicating in a general way how to mix the paint. We know that old work and new differ in paint requirements, that paint to be used in cold weather must differ from that intended for warm weather, all of which has already been stated. But even under these general heads scarcely two jobs are alike in all things; each usually demands its own special treatment.

It may be stated in a general way that so much lead requires so much thinners. Say 100 lbs. of pure white lead is to be mixed for new exterior painting; the quantity of oil required will vary with conditions. And each coat will require its certain amount of oil. In a general way it may be said that five gallons of oil is enough for the hundred weight of lead. But as

little as four gallons may do in some cases, while as high as seven gallons may be advisable in others. For old exterior work for the first coat it may be advisable to add some turpentine, and in this case a gallon of this fluid to four gallons of raw linseed oil will usually answer. Adding about a half-pint or so of driers. For the second coat less oil and turpentine may be used; say four gallons of oil and one quart of turpentine, with about the same quantity of driers as for the first coat.

For new exterior work more oil will be required for the purpose than for old work; the reason is that new wood is more absorbent of oil than old wood, which has been painted and hence contains some of the original paint in its pores.

No subject connected with paint and painting has been more discussed by painters and paint experts in paint chemistry and manufacture than the chalking of white lead paint. What has been said before conventions of master painters and in the paint trade journals would fill many volumes, and while opinions differ and theories have been laid down, yet in a general way it would appear that the fault is due to the lack of sufficient oil in the white lead paint, and the trouble is usually worst in the case of white exterior painting. The cause is a chemical one; the lead and oil are chemically active and a lead soap is formed that must necessarily be injurious to the paint. Just

how to prevent this chemical activity is a problem for the paint chemist. It is said that the addition of barytes does the trick. The idea is purely theory, it being supposed that the barytes, being a neutral or chemically inactive substance, will separate the particles of lead and oil and prevent their acting one on the other. Paint manufacturers favor this idea, and it may be added that many painters also favor it; many say that from actual experience and experiment they have proved the matter, As for the oil content of an outside paint, is seems to be well established that the more oil that can be used, avoiding a too thin condition for all coats after the priming, the better the paint will wear. This agrees with my painting experience; I have found that a thin paint will outlast a heavy bodied paint, this particularly applying to white lead exterior paint. Finally, I would advise that exterior oil paint mixed for at least the last coat, be made rather thin, or at least not heavy with lead.

For interior painting, which we shall now consider, the purpose of the paint is not to withstand weather conditions, hence need not be heavy bodied, especially in the case of an oil-and-color paint. Yet there must be body enough to form a solid-appearing surface. White paint will naturally carry more lead and hence have more body than a colored paint, because it must be mixed with turpentine, which is thin as

compared with linseed oil. For priming new interior woodwork mix the paint in the proportion of raw oil and turpentine equal parts; for 100 lbs. of lead use about five gallons of each liquid. Add about a pint of best turpentine driers. For second coat about half as much turpentine as oil, or one gallon of oil and two to two and one-half gallons of oil. For third coat, if it is to be left glossy, or enamel finish, add at the rate of 3½ pounds of zinc white to a gallon of demar varnish. For egg-shell gloss, to 100 lbs. lead, or in this proportion, 3 gallons pure turpentine and one pint of best pale driers. To secure a dead-flat finish the lead should be mixed with all turpentine, and drawn lead will give a better job than the lead that contains all the oil that it was ground in.

Drawn lead may be thus described: Mix up white lead that has been ground in oil with some benzine, let it then stand some time, or until its oil has risen to the surface, when it may be removed. Mix again with benzine, and repeat this until no more oil arises. Then mix the lead with all turpentine, and add a little good varnish, to serve as a binder in the absence of the oil.

In order to secure a clear white job, on either new or old work, add no oil to the paint, except on the priming. The same may be said regarding delicate or light tints. Oil has a natural yellow color, which becomes darker with time, unless exposed to strong

light and to the weather. They bleach raw linseed oil by placing it in a clear glass vial and hanging the vial where the sun can shine on it all day. So that it is the sunlight, rather than the weather, that bleaches the oil.

Plastered walls also are painted, and the paint in the main is like that used on the woodwork. The first coat or primer requires more oil than that used for priming wood. As much as 8 gallons of oil to the 100 lbs. of lead and boiled oil is best, which is just the opposite with wood priming. In addition to the oil add also two or three quarts of turpentine, no driers being needed with boiled oil. After the priming coat has become dry give it a coat of weak glue size. Upon this point there is a diversity of opinion among experts. Some argue that the glue size may become affected with the dampness usually present in plaster walls, and so affect the entire job. Some advise using the glue size on the wall before priming it, but this would not be safe to do if the wall were subject to dampness; it would do if the wall was normally dry. But the glue being between two coats of paint the danger of the dampness affecting it is a negligible matter. But why the glue size between the coats? It is easily seen what good it might do on the bare plaster, filling the surface and saving paint, but it is not so apparent what good would result from placing it between two coats of paint. The answer is, the

size between the two coats of paint does just what it does on the bare plaster, only in a more limited manner; it makes the sealing of the pores of the plaster and priming surer. It makes a firm and solid foundation for the subsequent coats.

As with woodwork, there are several finishes used for plastered walls. The dead flat, the egg-shell gloss, and the full gloss. The paint is about the same as that indicated for inside woodwork.

Another special form of paint is that intended for using with a paint spraying machine. As this paint must pass from the machine in the form of a very fine spray, it is obvious that it must be made very thin, and such is the case. So thin indeed that one might question the practical value of such a coating. It is claimed that by the more even distribution of the paint a denser film is secured than is obtained by the brushing method. Again, by the application of two spray coats to one brush coat is secured as good a surface, and probably a better. But to prepare the paint is our most interesting part of the discussion. It is easily disposed of. Mix the paint in the manner usual for exterior or interior paint, and thin it up with oil or turpentine or parts of both, as may be required. The paint may be made nearly or even quite as heavy as ordinary paint, for some nozzles will spray it all right; this depends upon the size of nozzle and purpose of the paint. Varnish also is used with this

machine. The spray is in the form of a vapor floating in the air, and much of it does not attach to the object being treated. The paint must be perfectly made and strained in order not to clog the nozzles. Water paint as well as oil paint and varnish are used in these machines.

Paint for Brickwork.—Like all surfaces that are to be made ready for painting, brick walls, whether new or old, excepting old walls that have been painted and are not in bad condition, need to be primed, to fill the pores. For new work it is best to apply raw oil alone, or with some Venetian red or yellow ocher—preferably the former pigment. Then two coats of oil paint on this priming should give a good glossy surface. The paint for the coat applied over the priming may be made from Venetian red or white lead, according to what the finish is to be, thinned with raw oil, and good driers to insure proper drying. This paint may be made with a fairly good body, but not heavy. The next coat, if the finish, may be whatever is required, but usually it is a full gloss finish. In that case it will likely be a red, using Venetian red, dry, and either raw or good boiled oil. But if the finish is to be in imitation of bricks, then a different course must be taken. The under coat, the one just beneath the finish, needs to be made with equal parts of oil and turpentine, using raw oil. This will give a hard, semi-flat surface upon which to apply the flat

brick color or finish. Often brick walls are painted with Venetian red mixed in raw or boiled oil, producing a glossy red finish. But flat brick work is much finer, and of course much more expensive. In cities, Philadelphia being a notable example, this flatting of brick work is usually given to experts who do no other kind of painting. The brick paint used comes ready made, in several shades of color, such as light, medium, and dark brick red, and in the buffish shades, and they are ready to apply after being thinned. The red brick colors are made very thin with turpentine, in order to give a very solid brick effect, showing no brush marks. The colors composing them are strong and stand a lot of thinning. The buffish colors may be applied as flat, or be made semi-flat or glossy, as desired. As a rule they look better if more or less glossy. But the reds are better flat. The latter are lined to imitate the mortar joints.

The painter should know how to mix these brick colors, as occasion may arise when it is desirable to do so. A good brick red of light color may be made with two parts best French yellow ochre, one part of the best Venetian red, and one part white lead. Mix with raw oil, thin with turpentine, and add driers. To the above, to produce dark brick red, add Prussian blue to any desired amount to get the shade you desire. The darkest brick red is purple-red. The lightest is buffish red. The intermediate colors will

show some of both these colors. The buff brick colors are made from ochre as the base, and several modifications of this color may be obtained by adding other colors, say umber, and raw sienna may be used in place of ochre if desired. It may also be tinted with a little Prussian blue, to impart a slight greenish cast. Milwaukee brick color is made from white lead, yellow ochre and raw sienna, from which may be obtained any shade ranging from light cream to a positive buff.*

To estimate the amount of paint required for painting brickwork, we must take into account the condition of the work. In a general way it may be estimated that a square yard will take about one-half pound of ordinary paint. For painting a new brick wall of the best class, with pressed bricks lined and of smooth surface, there will be required little more paint than indicated for new white pine.

Paint for Cement Surface.—Cement is very caustic and of course destructive to ordinary oil paint. If the work has stood to the weather for say one year it will take the paint with some assurance of its wearing well. Otherwise the surface must be treated with some liquid to kill the caustic. There are certain liquids for this purpose, and they are claimed to be effective. At any rate, we know that oil paint when

* See Chap. X, p. 66, for brick color formulas.

applied to fresh cement or to concrete will soon deteriorate and peel off.

Laying aside the matter of the fitness of cement or concrete to receive and hold oil paint, if such surfaces are to be painted we have the following formulas for making a suitable coating. For the first or priming coat, to 100 lbs. of white lead use 4 gallons of real boiled oil or 9 gallons of raw oil, and 1 gallon of turpentine, with about ½ pint of good driers. The driers need not be used if the boiled oil is used. The next coat may be made from 4 gallons of raw oil and 1 pint of turpentine, with a pint of driers. As three coats are necessary, let the third and last one be made with 3½ gallons raw oil and one pint of turpentine.

For painting on cement the best grades of pigments and liquids must be used. Zinc white does not do, being too hard. Some painters claim to get good results from the employment of red lead for the priming coat, this being the formula: Pure dry red lead, 85 lbs., pure kettle boiled linseed oil 1 gall., pure gum turpentine spirits 1 quart. Red lead should form a good coating, being hard and elastic, but if light color is desired for the finish the red lead will have to be well covered with other paint to prevent its discoloring action on the finish. A German method calls for the addition of a pound of beeswax to 25 lbs. of white lead for a priming coat. The wax is melted or dissolved in turpentine. This is said to make a very

durable coating, and reminds me of a formula for exterior paint once given me by an old expert painter; he added wax to the paint.

As cement is caustic certain pigments cannot safely be used for painting it. The following pigments are immune from alkali in any form: Yellow ochre, zinc yellow, red or burned ochre, iron oxide, ultramarine blue, ultramarine green, zinc white, lithopone, mineral black. The earth colors are of course safe.

In painting over cement it is best to use little oil, depending on turpentine as a thinner. This does very well at any rate when a dead finish is desired. A flat paint for this purpose may be made with a paint thinned with turpentine and bound with a little varnish. That is for the first coat and the second coat. For the third coat thin with three parts boiled oil and one part turpentine. The next and last coat is to be made flat. Thin with turpentine and add some varnish to bind it.

In painting over cement it is well to use more turpentine than in ordinary paint, and very little driers. Boiled oil, if the genuine article, is preferable to the raw. The priming coat should be thin and contain next to no oil, but mostly turpentine. Increase the proportion of oil with each coat, excepting where a flat finish is to be made, then let the last coat be as indicated, all turpentine. Observe also to allow each coat plenty of time for drying thoroughly.

Mixing Paint for Metal Work.—Red lead is the best of all pigments for first-coating iron and steel. Red lead varies in manufacture, there being several kinds on the market. It is a mixture of red lead and litharge. It is the litharge that causes red lead paint to settle in the pot as it does. The more litharge that red lead contains the heavier it is and the less its covering power. The Government requires of a red lead that it contain at least 94 per cent. of red lead, and most railroads require a similar quality. Red lead should be used in the dry state, and be mixed where it is to be applied. This because it will settle more or less anyhow, and become hard in the pot, unless frequently stirred. No driers are required with it as it is a strong drier itself. The best red lead is finely ground, and in this condition settling in the pot is less than is the case with a coarser lead. Mix red lead paint rather thin, and keep it stirred while using it. Clean out the paint pot when done with the paint, unless there is much of it left, in which case cover tight. If possible mix only enough for the day's work.

A very good thinning of red lead for paint may be made with one gallon of raw oil and one quart of turpentine; if then not thin enough to spread well add a little more oil. As a rule, turpentine should not be used with red lead,* excepting in cold and

* This applies to red lead paint intended for coating metal.

damp weather; but it makes the spreading easier. Thin with raw oil in summer, with boiled oil in winter. When boiled oil is used do not get the paint too thick, for that would cause it to wrinkle.

There are ways for preventing red lead from settling in the pot, such as mixing dry red lead with water, then stirring in the oil. Another way is to add some whiting, and this is good for more than one reason; it not only prevents settling in the pot, but it will also prevent sagging, a fault due to the heavy nature of the lead. It makes the paint easier to work, holds the lead in suspension, and adds to the elasticity of the paint. Whiting does not alter or injure the paint. You must not add too much whiting, though as much as one-half may be used without injuring the qualities of the paint, nor will the color be visibly altered. Often red lead paint is colored a little with lampblack, which also improves it, it is thought.

For painting cast iron work thin up dry red lead with ¾ raw oil and ¼ turpentine. Or use all oil if you wish. The second coat may contain some turpentine, but the third and last coat should be thinned with oil only.

When you make up a mixture of red lead and lampblack use boiled oil and a little driers. This because such a paint will dry slowly unassisted. The lampblack being a very poor drier it prevents the paint to which it is added from drying properly. However, it

is not solely on this account that we add driers and boiled oil, but mainly because these liquids serve to bind the lead and black in oil and prevent their separation. Lead being so much heavier than lampblack will naturally separate from it and settle.

Here are some good working formulas, in use by large corporations, such as railroads, etc. The proportions can be reduced, of course, to meet smaller requirements.

To 100 lbs. of dry red lead add from four to five gallons of raw linseed oil, one quart of good drying japan, and a quart of good copal varnish.

To 100 lbs. of dry red lead add four gallons of raw linseed oil, one quart of turpentine, and from one-half to one pint of best drying japan, according to weather conditions, or whether for slow or quick finish.

To 100 lbs. of dry red lead add 4 gallons of raw linseed oil for summer, and same quantity of boiled oil for winter, one gallon of turpentine, and one-half gallon of driers.

If it is desired to use black with the paint, add at the rate of ten ounces of lampblack to twelve pounds of red lead, mixing with enough oil to make one gallon of paint.

Taking the first formula given, let us make up a suitable paint with it. For a priming coat, on iron or steel, thin 11 lbs. of dry red lead with one quart of oil; this will make a thick mass; let it stand a

while. Then thin with one pint of raw oil and a gill of driers. This will make two quarts of mixed paint. For the second coat take 10 lbs. of red lead and 3 ozs. of lampblack and one quart of oil. Thin this with a pint of oil and a gill of driers. The paint should be mixed thoroughly and then be strained. Such paint will cover 700 square feet, one coat, average iron surface.

Different mixers use different proportions of red lead and oil. One railroad paint shop adds 21 lbs. of red lead to the gallon of oil. A bridge-painting concern specifies the use of red lead in the ratio of three and one-half parts red lead to one-half part of oil, all by weight.

A non-hardening red lead paint may be made on this formula:

65 lbs. dry red lead.
10 lbs. dry pulverized silica.
10 lbs. dry China clay.
1 lb. driers.
1 lb. turpentine (or substitute).
20 lbs. raw linseed oil.

Paint for Metal Roofing.—Paint for tin roofs must be mixed thin, for the reason that there is no porosity to take the paint in, and hence it remains all upon the surface; if the paint is heavy it will chip and peel when it gets hard-dry. If the paint is to be used in

warm weather it will require very little pigment, and no driers at all. In cold weather it will require some driers, and still will need to be thin. Such paint is to be well brushed out, and all runs wiped away. Venetian red is thought by many painters to be the best pigment to use, but iron oxide does very well too. Graphite paint should not be used, nor white lead or zinc. Red lead paint is good. Some experts advise equal parts by weight of pigment and oil. That would be at the rate of 7½ lbs. of dry pigment to the gallon of raw oil. To mix, put the pigment in a suitable vessel and pour the oil on top of it; let it stand until the oil has percolated through the pigment, which will require several hours, say over night. Then it is an easy matter to mix it to a smooth paste. To use red lead paint it is advised to thin with turpentine and oil, with driers if conditions seem to require it. Red lead is costlier than Venetian or oxide red, and perhaps is not more efficient than the two cheaper kinds mentioned. What is called mineral brown is simply red or brown oxide of iron.

Paint for Metal Ceilings.—Usually this metal comes to us with its first coat on, it having been dipped in a thin mixture of varnish and benzine, with zinc white to give body. The paint for this stamped and primed sheet steel may be made as for plaster or wood-work. The first coat contains a neutral pigment, zinc as we here give it, for a chemically active paint or pigment

would cause the metal to rust. But after it has been properly primed you may use any sort of good pigment paint desired. The best effects result from a finish of flat paint, which is better than any degree of gloss.

Paint for Galvanized Iron.—Any ordinary good oil paint does for galvanized iron, but only after the metal has been properly treated to take the first coat, and perhaps after it has been specially primed. For permanency on this peculiar metal the painter is advised to use any of the following pigments: Red lead, burnt umber, burnt sienna, Indian red, Prussian blue, lampblack, graphite. The poorest adhering pigments are zinc white, lithopone, clay, silica, and some others of this character.

CHAPTER X

COLOR FORMULAS. HOW TO MIX TINTS, ETC.

There are hundreds of colors, tints, hues and shades the names of which are in but comparatively few cases familiar to the average painter. Yet it has been thought best to make a complete list of them, or as near as possible, and to make it easier to find any desired color we have listed them according to their most pronounced color feature. As many cannot be so classed, these have been placed in a separate section, without rendering their place more difficult to find. We will begin with the reds.

Colors In Which Reds Predominate

Armenian Red. Venetian red 2 parts, yellow ochre 1 part.

Ashes of Roses. Tint pink a little with drop black.

Brick, Milwaukee. White lead 400 parts, French yellow ochre 32 parts, raw umber 1 part.

Brick Red. White lead 4 parts, Venetian red 2 parts, Indian red 1 part.

Brick, Philadelphia Pressed. White lead 4 parts, Venetian red 2 parts, Indian red 1 part.

Brick, Dark. Add blue to red brick. By varying

proportions any desired shade or color of brick may be made from the above colors. Salmon or soft brick may be made by adding plenty of ochre and white lead; there is little or no red in this brick.

Carnation. White lead 12 parts, scarlet lake 1 part; or zinc white 16 parts, scarlet lake 1 part.

Cherry Red. English vermilion 2 parts, No. 40 carmine 1 part.

Coral Pink. White lead 10 parts, vermilion 3 parts, orange chrome yellow 2 parts.

Damask Red. Rose madder or French carmine and a very little scarlet lake or vermilion.

Geranium Pink. Zinc white 60 parts, geranium lake 1 part.

Imperial Orange Red. Solferino lake 4 parts, yellow lake 1 part.

Moorish Red. Aniline vermilion 3 parts, rose pink 1 part.

Mexican Red. Venetian red 4 parts, red lead 1 part.

Old Pink. Zinc white, rose lake, and raw umber.*

Old Red. Tuscan red, drop black, and a drop of white.

Old Rose. Tuscan red and drop black, with a very little white. Or, rose madder or carmine, white, and a drop of black.

*Such colors are difficult to describe in terms of parts. There are several such in these lists.

Opaque Crimson. Carmine 2 parts, English vermilion 1 part.

Orange Vermilion. Orange mineral.

Oriental Red. Indian red 2 parts, red lead 1 part.

Peach Blossom. Tint white with King's yellow.

Pink, Opera. White 50 parts, vermilion 5 parts, medium chrome green 1 part.

Pink, Opaque. Equal parts of white lead and orange mineral.

Pink, Royal. Zinc white 2 parts, carmine lake 1 part.

Pink, Shell. White 50 parts, English vermilion 2 parts, orange chrome yellow 1 part, burnt sienna 1 part.

Pompeiian Red. Mix dark Indian red and red lake. Or use a good deep Tuscan red.

Rose. Tint white with carmine.

Rose, Carnation. Zinc white 8 parts, rose madder 1 part.

Rose Tint. White lead 16 parts, English rose pink 1 part; or, white 16 parts, Munich lake 1 part.

Rose, pale tint. Zinc white 32 parts, Florentine lake 1 part.

Rose, deep tint. Zinc white 8 parts, Victoria lake 1 part.

Rose, Royal tint. White 16 parts, English rose lake 1 part.

Scarlet Tint, deep. Vermilion 8 parts, carmine 1 part, zinc white 1 part.

Turkish Crescent Red. Indian red 1 part, aniline vermilion 1 part, rose pink 1 part.

Tuscan Red. Indian red 8 parts, rose pink 1 part.

Vermilion, rich. English vermilion 3 parts, orange mineral 1 part.

Colors In Which Blue Predominates

Azure Blue. Zinc white 1 part, cobalt or ultramarine blue $\frac{1}{40}$ part.

Electric Blue. Mix Chinese and Prussian blues and add a touch of red.

Gothic Blue. Indigo or Chinese blue, white, and a drop of black.

Old Blue. White, Prussian blue and a little yellow.

Peacock Blue. White 90 parts, light chrome green 5 parts, ultramarine blue 4 parts, drop black 1 part.

Purple, deep tint. White 3 parts, ultramarine blue 1 part, rose pink 1 part.

Purple Slate. White 60 parts, ultramarine blue 3 parts, Indian red 1 part.

Purple, Regal. White 4 parts, cobalt blue 2 parts, carmine 1 part.

Purple. Zinc white 4 parts, ultramarine blue 2 parts, carmine 1 part.

Purple, transparent. Cobalt or ultramarine blue 1 part, No. 40 carmine 1 part.

Sky Blue. White 90 parts, Prussian blue 1 part.

Violet, transparent. Ultramarine blue 4 parts, orange mineral 1 part.

Violet, tint. White 6 parts, ultramarine blue 3 parts, English rose lake 3 parts, ivory drop black 1 part.

Violet, white. White, vermilion, Prussian blue, and lake. Or, carmine, ultramarine blue and a very little of drop black.

Colors In Which Green Predominates

Absinthe Green. Tint white with Paris green.

Bottle Green, oil color. French yellow ochre, medium chrome yellow, Prussian blue and drop black. Match with green glass as seen in bottle of that color; the broken edges give the best idea.

Bottle Green, for vehicle, varnished effect. Add Prussian blue to Dutch pink, and on this color glaze with yellow lake.

Brilliant Green. White and Emerald green.

Electric Green. Add some Electric Blue to medium chrome yellow.

Invisible Green. Add a very little medium chrome yellow to lampblack or drop black.

Moss Green. Mix Prussian blue, medium chrome yellow, raw umber and white. Or, chrome yellow, raw umber, and white.

Olive Green, light. White 70 parts, yellow ochre 15 parts, medium chrome yellow 5 parts, raw umber 6 parts, drop black 4 parts.

Olive Green. Yellow ochre and lampblack.

Parrot Green. Ultramarine blue, Dutch pink, and lemon chrome yellow.

Silk Green. Mix Prussian blue and lemon chrome yellow, and French yellow lake. This is an expensive lake, and may be replaced with Dutch Pink.

Subdued Green. Mix Prussian blue and lemon chrome yellow and add a little raw umber and white to obtain the right shade. Or, add raw umber and white to medium chrome green.

Tea Green. Raw umber, chrome green and yellow ochre.

Willow Green. Verdigris and white.

Colors In Which Yellow Predominates

Acorn Yellow. Equal parts of white lead and raw sienna.

Amber Yellow. Medium chrome yellow 8 parts, burnt umber 5 parts, burnt sienna 3 parts.

Aurora. Medium chrome yellow 1 part, English vermilion $\frac{1}{10}$ part.

Bronze Yellow. White lead 3 parts, medium chrome yellow 5 parts, raw umber 1 part.

Canary. White lead 80 parts, lemon chrome yellow 1 part.

Canary Yellow. White lead 6 parts, lemon chrome yellow 1 part.

Cane. Tint white lead with yellow ochre and sadden the color a little with burnt umber.

Car Body Yellow. Medium chrome yellow 1 part, yellow ochre 1 part.

Colonial Yellow. White lead 95 parts, yellow ochre 3 parts, lemon chrome yellow 2 parts.

Cream. White lead 98 parts, yellow ochre 1½ parts, lemon chrome yellow ½ part.

Golden Tint. White lead 30 parts, yellow ochre 5 parts, vermilion 1 part.

Golden Yellow. Lemon chrome yellow 10 parts, orange chrome yellow 2 parts, white lead 5 parts.

Ivory. White 98 parts, raw sienna 1 part, lemon chrome yellow 1 part.

Ivory White. A very clear but rather expensive ivory white may be made from French yellow lake, 2 parts, raw Italian sienna 1 part, and zinc white 97 parts.

Old Ivory. White tinted with raw sienna.

Jonquil. Tint white with medium chrome yellow.

Lemon Color. Lemon chrome yellow.

Limestone Tint. Tint 18 parts of white lead with 1 part of golden ochre.

Naples Yellow. White lead 160 parts, golden ochre 9 parts, orange chrome yellow 1 part.

Orange, pale. White lead 6 parts, orange chrome yellow 1 part.

Orange red. Deep orange chrome yellow.

Orange. Orange chrome yellow, or medium chrome yellow tinted with red.

Orange, tint. Equal parts of orange chrome yellow and white.

Primrose. Medium chrome yellow.

Russet Yellow. Orange chrome yellow, white, and burnt sienna.

Straw. White 90 parts, yellow ochre 7 parts, medium chrome yellow 3 parts; or, white 8 parts, medium chrome yellow 1 part.

Sulphur Yellow. Equal parts of white and lemon chrome yellow.

Yellow, transparent. Yellow lake makes the best. For a cheaper color use Dutch pink. Gamboge gives a bright color. Or, zinc white 8 parts, yellow lake 1 part.

Yellow, brass. White lead 40 parts, lemon chrome yellow 12 parts, burnt umber 1 part.

Yellow, rich. White lead 6 parts, medium chrome yellow 1 part.

Yellow, topaz. White zinc 4 parts, yellow lake 1 part.

Yellow, flesh tint. White lead 80 parts, light cadmium yellow 1 part.

The Buff Family of Colors

Buff. White lead 2 parts, yellow ochre 1 part.

Buff, deep. Tint yellow ochre with Venetian red.

Buff, light. Reduce yellow ochre with white lead.

Buff, medium. Add some white lead to ochre and tint with a little burnt sienna.

Buff, warm. Tint yellow ochre with Indian red.

Buff, dull. Add some burnt umber to buff.

Buff, transparent. Zinc white 3 parts, golden ochre 1 part.

Buff, rich. White lead 2 parts, yellow ochre 1 part. Or, tint orange yellow with raw sienna.

Buff, stone. Equal parts of white lead and ochre.

Buff, brilliant. The best grade of golden ochre.

Various Colors, Unclassified

Amber. Add a little white to yellow lake. Or, red lake and chrome yellow. Or, add a little chrome yellow to carmine.

Antique Brass. White lead 4 parts, medium chrome yellow 3 parts, Vandyke brown 1 part.

Auburn. Indian red, drop black and Venetian red.

Bay. Burnt umber, Dutch pink, and Venetian red.

Beaver. Drop black and burnt umber.

Bismarck Brown. Burnt umber, Dutch pink, red lake.

Brass Shade. Yellow ochre 4 parts, Vandyke brown 1 part.

Brown. Red and black.

Brown Pink. White lead 16 parts, Chatemuc lake 14 parts, Vandyke brown 1 part.

Burgundy. Asphaltum with good red lake.

Café au Lait. Coffee and cream. White, burnt umber, and medium chrome yellow.

Chestnut. Tone medium chrome yellow with red and black. Or tone yellow ochre with black and burnt umber.

Chocolate. White and burnt umber with a little medium chrome yellow.

Citrine. White lead 75 parts, yellow ochre 15 parts, burnt sienna 4 parts, drop black 6 parts.

Citron. Tinge orange yellow with chrome green.

Citron Yellow. White lead 16 parts, lemon chrome 12 parts, emerald green 1 part.

Claret. Tinge English purple lake with carmine. Or, tinge any good purple lake or carmine with ultramarine blue.

Clay Drab. Tint white lead with raw umber and raw sienna, with a mere touch of blue or green.

Copper Color. White lead 20 parts, medium chrome yellow 4 parts, Venetian red 3 parts, raw umber 1 part.

Dove. White tinted with vermilion, Prussian blue, and medium chrome yellow.

Dove Wing. White, ultramarine blue and drop black, with a touch of red lake.

Drab. White lead 88 parts, yellow ochre 10 parts, lampblack 2 parts.

Drab, reddish. White lead 90 parts, yellow ochre 8 parts, burnt umber 2 parts.

Egyptian Brown. Ivory black and burnt umber. With asphaltum for either solid or for glazing.

Electric Turquoise. White, electric green, and electric blue.

Fawn. White lead 94 parts, yellow ochre 5 parts, burnt umber 1 part.

Fawn Pink. White lead 25 parts, burnt sienna 3 parts. Or, white, drop black or raw umber, vermilion and medium chrome yellow.

Flax Tint. White lead 100 parts, yellow ochre 60 parts, lampblack 1 part.

Flesh Color. Zinc white 95 parts, English vermilion 3 parts, lemon chrome yellow 2 parts.

Flesh Ochre. Yellow ochre 31 parts, red lead 1 part.

Flesh Tint. White lead 120 parts, yellow ochre 2 parts, Venetian red 1 part.

Freestone. White lead 10 parts, Venetian red 1 part, yellow ochre 5 parts, lampblack ½ part. Freestone is a reddish-drab color.

Gold. White, yellow, red, and raw umber. Or, white, lemon yellow, and burnt sienna. Or, tinge yellow ochre with red and blue.

Golden Orange. Orange mineral 2 parts, golden ochre 1 part.

Greenstone. White lead 90 parts, medium chrome green 3 parts, raw umber 3 parts.

Gray. White, tinged to gray with blue, red and black. Or, with ultramarine blue, or lake, or burnt sienna, and indigo. For house painting this color is

made from white lead base, which is first tinted with a very little blue, then with a red—burnt sienna will do in place of a red.

Hay Tint. White lead 45 parts, golden ochre 15 parts, medium chrome green 2 parts.

Heliotrope. Carmine lake and white.

Isabella. Medium chrome yellow, burnt umber, and Venetian red.

Lavender. Zinc white 16 parts, mauve lake 1 part, rose madder 2 parts

Lavender Tint. Zinc white 80 parts, ultramarine blue 3 parts, carmine 1 part; or, white lead 48 parts, ultramarine blue 1 part, rose pink 1 part.

Lead Color. White lead 98 parts, lampblack 2 parts.

Leather. Tone down burnt umber and burnt sienna with white lead.

Leather, yellow. White lead 20 parts, golden ochre 2 parts, burnt sienna 1 part.

Lilac. White lead 96 parts, Tuscan red 3 parts, ultramarine blue 1 part. Or, vermilion in place of Tuscan red.

Lilac, American. White, red madder lake, and ultramarine blue.

Lilac, English. White, lake and Bremen blue.

Lilac, French. White, carmine and Prussian blue.

Lilac, rich. Zinc white 64 parts, mauve lake 1 part, madder lake 1 part.

Lilac, Tint. Zinc white 80 parts, ultramarine blue 1 part, No. 40 carmine 1 part.

Lilac, cheap tint. White lead 40 parts, rose pink 1 part.

Lilac, purple tint. Zinc white 16 parts, cobalt blue 1 part, carmine lake 1 part.

Limestone. White ochre, lampblack, and Indian red.

Mahogany. Golden ochre 5 parts, Venetian red 2 parts.

Maroon. Carmine, medium chrome yellow, and burnt umber. Or, carmine or crimson lake and burnt umber.

Mauve. Rosemadder, ultramarine blue and white.

Mauve, tint. Zinc white 12 parts, cobalt blue 4 parts, carmine lake 1 part.

Morello. Rose pink with a very little drop black and white.

Mulberry Red. Yellow ochre, burnt sienna and white.

Old Gold. White lead 10 parts, golden ochre 1 part, raw umber 1 part.

Olive, golden russet. Lemon chrome yellow and light Venetian red or burnt sienna.

Olive, drab. White lead 75 parts, raw umber 13 parts, medium chrome green 7 parts, drop black 5 parts.

Olive Ochre. French yellow ochre 7 parts, raw umber 1 part.

Orange Ochre. Yellow ochre 7 parts, Venetian red 1 part.

Peach. Tint white with yellow ochre, vermilion and purple-brown.

Pearl. White, vermilion, Prussian blue, and tone with drop black.

Pearl Drab. White, ultramarine blue, drop black, Venetian red, and yellow ochre.

Pearl Gray. White lead 98 parts, drop black 1½ parts, Tuscan red ½ part.

Portland Stone. Raw umber, yellow ochre and white lead.

Plum. White, Prussian blue, and Venetian red. Or, white, ultramarine blue, red lake or carmine, and a very little drop black.

Puce. Vandyke brown or burnt umber, and drop black, with a very little yellow chrome or ochre.

Roan. Ivory black, red, and a little white.

Roman Ochre. Yellow ochre 15 parts, burnt umber 1 part.

Russet. Mix orange and purple. Or red, blue, and yellow. It is a tertiary color.

Russet, pure. Orange chrome yellow 10 parts, medium chrome green 1 part.

Shrimp. White, raw sienna, and a very little vermilion.

Silver Gray. White 97 parts, yellow ochre 2 parts, lampblack 1 part.

Sorrel. Orange chrome yellow with a very little Venetian red; or, vermilion and yellow ochre.

Silver. White, blue and black.

Salmon. White 36 parts, golden ochre 4 parts, English vermilion 1 part; or, white 88 parts, yellow ochre, medium chrome yellow 2 parts, Venetian red 2 parts.

Salmon Tint. White 60 parts, vermilion 4 parts, lemon chrome yellow 1 part.

Sandstone. White, medium chrome yellow, and Indian red.

Slate. Tone white with red and darken with drop black and blue.

Snuff. Yellow ochre and Venetian red; or, chrome yellow, burnt sienna and Venetian red.

Spruce. White 80 parts, yellow ochre 10 parts, medium chrome yellow 6 parts, bright Venetian red 4 parts.

Stone. White, yellow ochre, burnt umber. Or, raw sienna, burnt umber and white.

Tan. White 90 parts, bright Venetian red 7 parts, medium chrome yellow 2 parts, lampblack 1 part.

Terra Cotta. White 2 parts, golden ochre 1 part, burnt sienna 2 parts; or, white 85 parts, burnt sienna 15 parts.

Terra Cotta, light. White 3 parts, raw sienna 1 part.

Terra Cotta, red. Equal parts of white lead and burnt sienna.

Terra Cotta, tint. White lead 20 parts, burnt sienna 1 part.

Tuscan Brown. Tuscan red, chrome yellow and drop black.

Vandyke Drab. Vandyke brown, white lead, yellow ochre, and drop black.

Vellum. Tint white with strong boiled oil.

Wine Color. Tinge purple lake with blue.

Additional Color Formulas

Apple Green. White lead 96 pounds, light chrome green 4 pounds.

Cream. White lead 98 pounds, French yellow ochre one and one-half pounds, lemon chrome yellow one-half pound.

Light Olive. White lead 70 pounds, French yellow ochre 15 pounds, medium chrome yellow 5 pounds, raw umber 6 pounds, drop black 4 pounds.

Peacock Blue. White lead 90 pounds, light chrome green 5 pounds, ultramarine blue 4 pounds, drop black 1 pound.

Pale and Deep Tints

Pale Tints.

Buff. White, ochre and burnt sienna.

Blue. White and ultramarine blue.

Cream. White with ochre or medium chrome yellow.

Drab. White, with raw or burnt umber.

Fawn. White with raw sienna and vermilion.

Gray. White with ultramarine blue or lake.

Gray. White with burnt sienna and indigo.

Gray. White with vegetable black or lake.

Gray. White with Prussian blue and Indian red.

Lilac. White tinted with vermilion and ultramarine blue.

Lavender. White tinted with Prussian blue and lake.

Pink. White tinted with crimson lake or rose pink.

Pink. White tinted with vermilion or Indian red.

Peach. White tinted with vermilion, yellow ochre and purple-brown.

Salmon. White tinted with vermilion and ochre.

Stone. White tinted with ochre and raw umber.

Straw. White tinted with light chrome yellow or Dutch pink.

The Deep Tints.

Brown. White, Prussian blue and Venetian red.

Brown. White, purple-brown and lake.

Brown. Same as above with addition of vegetable black.

Brown. White, indigo, yellow ochre and vermilion.

Chocolate. White, lake, purple-brown and vegetable black.

Green. White, ochre and indigo.

Green. White, raw sienna and Prussian blue.

Green. White, chrome yellow and Prussian blue.

Lead Color. White and black.

Orange. White, orange yellow and lake. Or, Dutch pink, white and lake.

Violet. White, vermilion, Prussian blue and lake.

Sage Green. White, Antwerp blue, and yellow ochre.

Pea Green. White and Brunswick green.

Duck Egg Green. White, ultramarine blue and light chrome yellow.

Blue. White and Antwerp blue, or white and indigo blue.

Sage. White lead, medium chrome green, raw umber.

Some Colors for Common Use

Green. There are many kinds of green, ranging from nearly black or brown to the palest tint. Strictly speaking many greens are green in name rather than in appearance. Yet all possess some green-making pigments. Thus, mixtures of blue and yellow ochre. Black and yellow ochre. Black and chrome yellow. The true or standard green is composed of blue and chrome yellow, in such proportions that neither predominates, yet both are seen by the color-educated eye. As the proportions vary the product will be dark or light green, or medium green. Thus of ordi-

nary painters' chrome green there are light, medium, dark and extra dark green. For cheap painting a serviceable green may be made with black and yellow. It would not be as true a green as where Prussian blue is used with the yellow. Few greens are permanent, that is to say, the true greens, but those made from black and ochre are not in this class, and while not true greens, and not very handsome, yet are stable and suitable for many kinds of work where durability is of more value than mere appearance. Ultramarine blue and zinc yellow make a durable green, and in place of the zinc yellow you may use yellow ochre. Such a green is not brilliant, nor can it be used safely with lead colors. Chinese blue and chrome yellow make the ordinary chrome green, but it is not permanent. This form of green is made at the factories. If made by the chemical process it will prove quite satisfactory as to permanency.

Bottle Green is a fancy so-called green color. It is made from yellow ochre, black japan, and Prussian blue for common purposes. The finer bottle green color formula is given under the head of The Greens.

Bronze Green. The true bronze green is made from orange chrome yellow, ivory drop black, and a small portion of burnt sienna. This finish, when seen under sunlight, should show a bronze lustre. But there are several forms of bronze green, some more on the bottle green order. Such a bronze green, so called, can be

made from medium chrome green, drop black, and burnt Turkey umber, or burnt sienna. These various pigments should be the best oil ground, and a light and dark shade may be had by using the chrome green of the right shade. Either the umber or the sienna may be omitted, but the black is essential to both bronze and bottle greens. Ivory drop black is the best to use, as lampblack gives the green a dull appearance, while gas black gives too much of a brownish tone. As drop black dries poorly it is necessary to assist it with a good quantity of a good japan drier.

CHAPTER XI

USEFUL SUGGESTIONS FOR THE PAINT MIXER

Here is a complete working formula for a chocolate brown paint:

White lead	100	lbs.
Burnt umber	25	lbs.
Burnt sienna	10	lbs.
Medium chrome yellow	2	lbs.
Raw linseed oil	5½	galls.
Pure turpentine	½	gall.
Turpentine japan drier	½	pint.

The amount of chrome yellow to use is left to your discretion. Two pounds may be too much, or not enough, so that you will use whatever quantity you think will make the desired brown. The formula given will make about 11 gallons of paint of good body, one that will allow of good rubbing out. As regards covering power, any paint mixture containing strong colors, like black, Prussian blue, yellow chrome, etc., will always be satisfactory. And white lead itself is a strong coverer, so that with it for the base and strong colors for the tinters, we have a paint of the utmost power.

How much paint will 100 lbs. of white lead make when mixed in oil ready for exterior or interior use? In answer we give the following working formula:

100 lbs. white lead.
5 galls. raw linseed oil.
1 gall. pure turpentine spirits.
1 pint of drying japan.

First, we have to know how many gallons the 100 lbs. of white lead will make. The answer is, 100 lbs. of white lead will bulk 2¾ gallons. Adding the liquids and we have very close to nine gallons of paint.

It is desirable to know how much lead will be required when about to mix a batch of paint, and how much of the thinners, etc., for otherwise we shall be merely guessing, and that is wasteful of materials and time. Of course, conditions vary so much that one formula will not answer for all, but to get the start we must know the capacity of each ingredient, what it is capable of, and what the resultant paint will do when ready to be used. Covering and spreading capacity are not the same thing. A paint may have great spreading capacity and yet not cover well. Take such a pigment as barytes or whiting, mix it with oil, and spread it on. It will spread on account of the oil it contains, but the covering will be very poor. Hence, in mixing paint you must have in mind the condition of the surface that is to be painted, its

nature, too, whether old or new work, metal or wood, etc. A paint may cover 700 square feet or 800 square feet. The capacity depends upon the thinness of the liquid.

How much oil is generally allowed to the 100 lbs. of lead? In a general way it may be said that five gallons of raw linseed oil will do for 100 pounds of white lead for general exterior painting. This will make allowances for conditions that are not equal to new work. Zinc white will take about half as much more oil.

A Useful Mixing Rule.—Some paint expert has given us a rule whereby we can know exactly how much pigment should be used to a gallon of oil, and below are a few samples of paint mixed in accordance therewith.

One gallon of raw linseed oil requires 26.40 lbs. of dry white lead.

One gallon of oil requires 21.20 lbs. of dry zinc white.

One gallon of oil requires 20 lbs. of Indian red.
One gallon of oil requires 12 lbs. of yellow ochre.
One gallon of oil requires 11.84 lbs. of umber.
One gallon of oil requires 10.40 lbs. of bone black.

Rule.—For each gallon of oil used take as much pigment as four times the specific gravity of the pigment.

List of Permanent and Fugitive Colors.—Chrome yellow is a lead chromate, or of the same nature as white lead, hence sulphur will affect its stability as it does that of white lead. It darkens, owing to the formation of black sulphide of lead.

The umbers and siennas, yellow ochre and the burnt ochre and Vandyke brown are stable colors.

Of the blues, ultramarine is the only stable color, as Prussian blue and the others, including indigo, either alone or in combination, will fade.

The stable reds include Venetian red, Indian red, light red, and madder lake. Avoid vermilion on exterior work; it does better when protected with a coating of good varnish.

For exterior use avoid a green made up of Prussian blue and chrome yellow: the blue will fade out. Some chemical greens stand very well, and if the color will suit you may make a green from French yellow ochre and black.

We speak of colors as being permanent and fugitive. As a matter of fact no pigments, in whatever combination they may be made, can be depended upon for stability; paint will deteriorate, fading or otherwise altering and losing in color and texture. Generally speaking, dark colors are more permanent and capable of better service than the lighter colored ones. The dark colors seem to preserve their lustre better than the light colors. But this, if considered as a rule, is

not without its exceptions. Dark colors certainly are affected worse than light colors by the action of the sun.

Imitation of Tube or Artists' Colors.—In many of the color formulas given in Chapter X the names of tube or artists' colors are given. The colors containing these tube pigments are mostly used by carriage painters, but they may be useful also to the house painter, and where it is not convenient to use or get them, or where the cost is too great, some of them at least may be imitated with the common pigments, such as house painters use constantly. Thus—

Madder Brown. Take a little Indian red and brown and add to cheap crimson; even cheap vermilion will sometimes answer.

Purple Lake. Take vermilion and darken with ultramarine blue.

Brown Pink. Take raw sienna and a little Vandyke brown, with just a touch of Prussian blue.

Aureolin. May be imitated with medium chrome yellow and a bit of white.

Cobalt Green. White lead, Prussian blue, and a little Brunswick green. Or, white lead, ultramarine blue and Emerald green.

Sepia. Burnt sienna and lampblack, with a touch of Indian red. Or black, Venetian red and burnt umber.

Many other fancy colors and artists' pigments may thus be imitated very cleverly, and it will pay to

practise when time affords, taking the tube color and trying to match it with the common painters' pigments.

To Darken Certain Colors.—Painters sometimes attempt to change the shade of the paint they have compounded, or of certain colors they have mixed, exactly in the wrong way, the result of which is that they get further away from the desired goal. Here are a few examples showing how to darken colors.

Greens. If the green needs to be deeper in tone add some of the dark pigment that it is composed of. Thus, green, add blue. If to be very dark, although not containing black, add of that pigment, and if a different or truer shade is desired, add Prussian blue.

Vermilion. To darken vermilion add Indian red. But it depends upon the shade you desire. Should you wish it different from what the Indian red will give, try Venetian red, burnt umber, or Vandyke brown.

Venetian Red, Indian Red. Add umber or Vandyke brown.

Umber or Vandyke Brown. These may be darkened with black.

To lighten green add yellow or white, according to color desired. To lighten Indian red or Venetian red add vermilion. To lighten umber or Vandyke brown add Indian or Venetian red.

To darken blue add Prussian blue or black. To lighten, add white.

Sometimes, when mixing a pot of paint, one gets it either too dark or too light. To get the right color you will have to add a very little of the correcting color at a time, or you may be in the position of one painter who, when he had done doctoring a pot of paint that was enough for a porch, had enough to do two houses. With some colors, say a gray, it is a delicate task to hit the right shade. The more experienced will have less difficulty, of course, than the amateur.

Colors, Permanent and Fugitive.—In a preceding chapter mention has been made of those pigments which are not stable, some being affected by sulphur in the air, others fading from the action of direct sunlight. It is thought well to have a table showing these pigments for handy reference. They follow:

Chrome Yellow, various shades, is acted upon by sulphur, which is usually present in all coal-burning cities. It is a chemical color, lead chromate, being made from white lead, which also is affected by sulphur, and when left uncolored on exterior work will darken greatly, from the sulphur action; sometimes such white painting assumes a decided lead color.

Earth Pigments.—These embrace the following: Sienna, umber, Vandyke brown, and yellow ochre. Venetian red and iron oxide are not considered as

pigments; though sometimes used for tinting, they are bases, or for use without addition of other colors. They too are stable.

Blues. Ultramarine blue is the only member of this family that is stable, and wherever such a pigment is necessary on that account, or where a pigment is required that is immune to the action of lime or alkali in any form, it is indicated. It is useful in water color made from a whiting base, for instance. It will do to blue whitewash also.

Reds. The dependable reds are Venetian red, Indian red, light red, and madder lake. For exterior painting do not use chrome red, carmine lake or vermilion. Where such colors can be protected with good varnish they do fairly well.

Greens. The weak point in an ordinary green consists mainly in its Prussian blue content; as has already been pointed out, this blue fades out of the green, leaving a rust color only to show where a former fine green existed. The chrome yellow also is affected, as already described, by sulphur, so that neither pigment forming the green is dependable. Paris green, formerly used in painting inside Venetian blinds, is permanent but very poisonous; it is extensively used by farmers in exterminating bugs.

There are chemical greens that are quite dependable, the blue and yellow being chemically blended so that they will not separate, as the common kinds of

chrome green do. Greens made from black and ochre, while not exactly greens, do well on exterior work.

The rule is that all pigments produced by the aid of heat will change under the influence of heat of a different character or temperature—they usually become deeper of color. Iron oxide paint is an example.

To Assist Slow-Drying Colors to Dry.—Some pigments are slow driers and must be helped; this in a general way will apply to all the pigments, but some are slower, some faster, as you care to put it, than others. Vandyke brown is an example of a slow drier; to help it add some burnt umber, which is a good self-drier and will not alter the color of the Vandyke to any appreciable degree. Then there is raw sienna, a poor drier too. A little raw umber will help it and if not used in too large an amount will not injure its color. The blacks are poor driers, but the addition of a little Prussian blue and red lead will help it and not alter its tone. Mix the blue and red lead to form a gray color before adding to the black. A mixture of Prussian blue and red will give a black that is much more intense than drop black. That is to say, it will strike the eye as such, though as a matter of fact it will not be as black as drop black.

White lead assists any pigment it may be added to to dry, being a good drier of itself. For this reason white lead is added to the black that is to form the ground for a smalts sign. In this case a lead color is

made dark, it is true, but when the black sand is sprinkled upon the dark lead ground the result is a dense black finish. A little lead is sometimes added to a black when used by the sign painter—not enough to be seen. Certainly, we have the liquid driers for the purpose, but in the case of some of the very slow pigments it would take too much driers to dry the paint, and harm would come of it. Better use the drying pigment to some extent.

The Whites Used in Paints.—The most familiar of the white pigments used in common painting are the well known white lead, zinc white and whiting. The others are not so well known to painters, as they come to them mostly by way of the paint mill. These, as well as the others, should be known as thoroughly as possible to the paint mixer, as well as to the paint applier. We shall begin with—

White Lead. Basic carbonate of lead. The metal lead of pure quality is acted upon by acid and heat, which produces corrosion of the lead, forming a white crust, which is the white lead of commerce. A curious feature of the process is worth noting in this connection; as the lead weighs so many pounds, say, when placed in the pots for corroding one would naturally expect the product to at least be less than the original amount; but instead of this we find a considerable increase in weight, so that the lead carbonate will be found, upon the scales, much heavier than the metal

lead was. The increase in weight gives the corroder a good profit, it is claimed.

The quick process needs not be described here, as we have done so in another place, as indeed has been, in a less degree, in the case of white lead.

Zinc White, oxide of zinc. This is a product of heat, an oxide, as distinguished from white lead, a carbonate. There are several grades, and what is commercially known as French zinc is not made in France, but is, or was before the war, made in Belgium. But the term means a grade, a superior product being now made in our own country.* Zinc is familiar to painters, and has been described briefly in another chapter.

Whiting. Carbonate of Lime. One of our most useful whites. With it water color painting is made possible at a minimum cost, and without it how should we make putty? There are several grades. The kind most used by the painter is called gilders' bolted whiting, a grade suitable for water color work or putty. Whiting may also be used sometimes when making a paint where pure lead paint is not necessary, as in rough or cheap painting. As it has a very poor body and great bulk, in mixing for paint, or with lead paint, the mixer will think it incapable of forming a paint with sufficient body. It is best to place about

* Wherever French zinc is mentioned in this work it means a zinc white made in the United States.

what you think will do, in a pot, and pour oil over it, and let the oil percolate through the whiting, just as is done in making up water color paint.

Gypsum. Hydrated calcium sulphate. A natural lime sulphate, from which is made plaster of Paris, so called because made in large quantities in the city of that name, it being built upon a solid bed of the substance. Some other names are terra alba or white earth, and some commercial water paints are made with it as the base.

China Clay. Hydrated aluminum. Known as white bole, kaolin, etc. Some forms of ready made paint contain china clay as the principal base.

Blanc Fixe. Precipitated barium, permanent white, a superior grade of barium, used in certain paints.

Barytes. Barium sulphate. Heavy spar. A heavy natural rock, ground and prepared for making certain forms of paint, sometimes as adulterant, but often to improve an exterior paint.

Silica. Silicon dioxide. Silex, quartz. A very useful pigment, when ground very fine. Used also in making wood filler. It is used in some ready mixed paints, in place of barytes, it being preferable in some respects.

Soapstone. Hydrated magnesium silicate. Steatite talc, French chalk. Varieties give different products. One product finds some use in a paint for certain purpose. It is called soapstone.

Pigments Not Affected by Alkali.—Barytes, whiting, yellow ochre, Venetian red, Indian red, cobalt blue, ultramarine green, sienna, Vandyke brown, oxide of iron, lamp black, drop black, ultramarine blue.

Pigments Proof Against Lime.—Barytes, lithopone, zinc white, whiting, china clay, yellow ochre, Indian yellow, iron oxide, madder red, and in less degree, red lead and English vermilion, cobalt green and terra verte, umber and Vandyke brown, lampblack and drop black, cobalt blue and ultramarine blue.

Pigments Not Affected by Sulphur Gas.—Zinc white, barytes, silica, China clay, Lithopone, terra alba, and whiting. Zinc lead and sublimed lead are nearly sulphur-gas proof. Yellow ochre, Venetian red, Indian red, Tuscan red, ultramarine green, all the brown earth pigments, such as umber, Vandyke brown, the iron oxides, lampblack, drop black, and ultramarine blue.

Pigments that Contain Sulphur.—Vermilion, that known as sulphide of mercury, such as Chinese, English, and German; cadmium yellow, which is sulphide of cadmium; ultramarine blue and sulphide zinc white.

Notes on Zinc White

The only action which sulphuretted hydrogen can have on zinc is to form zinc sulphide, which is itself a white and, therefore, does not injure the color of the white coat; even in tinted coats the action can hardly

be noticed. It is a question however whether the sulphide of zinc is formed at all.

Zinc oxide is prepared from (1) metallic zinc and (2) from zinc ore. The latter is known as the indirect process, and is mostly used in the United States.

Pure zinc has an extraordinary capacity for spreading, much more so than white lead. But spreading must not be confounded with covering, as understood by painters. A much larger area can be covered with pure zinc white than with white lead, but the coating would not be as solid.

Zinc white should always be kept in tins or in tinned iron vessels. If placed in wood the wood will absorb the oil from the paste and the zinc will be more or less dry and hard, and not as good again. Water should not be used to cover it as you would cover white lead; water injures the zinc; use oil instead.

The best zinc oxide has an apparently poorer covering quality than white lead, but we are told by those interested in the matter that if we take zinc and white lead, pound for pound, and not by mere bulk, zinc being bulkier than lead, we shall find that it covers equal to lead. It is said that the lower grades of zinc oxide, or what passes for such, have very much less covering power than the best grade. White lead cannot easily be adulterated to any extent without detection by an expert painter. It is different with

zinc, which may easily be adulterated and then its faults are blamed upon the zinc itself.

To test the purity of zinc oxide in its dry state it may be heated and then allowed to cool, when if pure it will return to its original white. Boiled in dilute nitric or muriatic acid it should dissolve completely without effervescence. If it effervesces during solution there is some carbonic acid present, due to white lead, whiting, or to zinc carbonate. If any insoluble matter be present it is most likely barytes. To test zinc white in oil wash out the oil with gasoline or ether, dry the pigment, and test as above.

Leaded zinc is now adopted to indicate an oxide of zinc which contains a proportion of basic sulphate of lead. The presence of lead is due to the mode of production of the pigment, and the nature of the ore from which it is obtained. An authority has brought out clearly that provided the proportion of lead did not exceed a reasonable limit the pigment did not suffer, but on the contrary became a better protective medium.

Practical Notes for the Paint Mixer

If you are about to mix some colored paint you can save labor and time by breaking up the lead and color separately, and then straining each before adding to the lead mass.

A rule that is pretty general among paint makers

is to add one-half pint of driers to a gallon of raw oil, which is calculated to dry the paint in from 18 to 24 hours, in fair weather. As this rule calls for the best turpentine driers it would seem to be a rather large amount. But the amount must always depend upon conditions, as explained in a preceding chapter.

If you wish to add a little oil to a japan color first mix the japan color with a little turpentine, then it will mix readily with the oil, which may then be added to the color, which will not curdle.

When mixing paint to get a tint, add the lightest color first, then the darker one, according to depth of color and tinting strength.

If too much turpentine is added to exterior paint it will be hard, not sufficiently elastic; such a paint will become hard and brittle, cracking later.

Boiled oil is a sort of oil varnish, hence if too much is used in outside paint the paint film will be soft, and apt to wrinkle. Too much driers also makes a soft paint, which does not dry well.

Stir the paint always with the paint paddle, never with the paint brush, as many painters do.

Study the various paint materials and understand which is best suited for any special purpose.

Unless the odds and ends of paint are used up right along they will accumulate and be a waste. Try to incorporate them with some paint that you may have to mix each day. If so used, while fresh or not fatty

they will not injure the paint in any way, but in some cases improve it. Colored leftovers must of course be used with colored paint, and only white remainders be used with white paint.

Keep the keg or can of white lead covered with water, and the can of zinc-white covered with oil. Oil on top of each opened pigment can is good.

If when beginning to mix a pot of paint you add too much oil the lead will become lumpy and be very much harder to mix to a paste than where you add a little oil at a time.

When a paint made from white lead, especially where drying colors are used, is thinned mostly with turpentine less driers should be used than where oil is the chief liquid thinner.

The most valuable iron oxides for painting are the bright reds, the browns, and the yellows.

It is economy to buy the best grades of colors. It will require three pounds of cheap chrome yellow to do the same amount of tinting that one pound of the best grade will tint. Nor will the poorer article give as rich a tint. Eight ounces of the best lampblack will go farther and do better work than two pounds of cheap black.

When applying paint stir it now and then, to keep the ingredients mixed. The liquids naturally come to the top, and the solids go to the bottom, and the heavier the pigment the worse the settling.

Of the two, thin paint does better than thick, but it will require more coats to afford the same protection. Heavy paint does not brush out well. It is apt to crack and scale. Thin paint is more elastic owing to the greater amount of oil.

Don't mix too much paint for the work in view; if any is left over place it in a can and cover it tight, to exclude the air; also label it so that you can tell at a future time what it is.

Tests seem to have proved that a paint thinned with 90 parts of boiled oil and 10 parts of turpentine is less porous when dry than a paint made from either raw oil or boiled oil alone.

Too much oil with white lead will cause it to sag or run; yet it is desirable to mix as much oil as possible. It is the life of a paint.

A List of Perfect Color Combinations

Black and white.
Blue and gold.
Blue and orange.
Blue and salmon.
Blue and maize.
Blue and brown.
Blue and black.
Blue, scarlet, and lilac.
Blue, orange, and black.
Blue, brown, crimson, and gold.

Blue, orange, black, and white.
Red and gold.
Red, gold, and black.
Scarlet, and purple.
Scarlet, black, and white.
Crimson and orange.
Yellow and purple.
Green and gold.
Green, crimson, turquoise, and gold.
Green, orange, and red.
Purple and red.
Purple, scarlet, and gold.
Lilac and gold.
Lilac, scarlet, and white or black.
Lilac, gold, scarlet, and white.
Lilac and black.
Pink and black.
Black, with white or yellow and crimson.

It will be noted that the above table gives black, gold and white places in many instances. These three colors, counting gold a color, agree with all other colors, so that you cannot go wrong when placing any of them next to any other color. The above table was compiled by an artist. Of course a very much larger table could be formed, for there is hardly any limit to the number of perfect color combinations.

A study of the primaries, secondaries and tertiary colors is helpful in arranging harmonious colors.

Mixing Various Special Paints

Bath Tub Enamel Paint.—Break up eight pounds of best French process zinc white that has been ground in damar or other light varnish, and mix with it one-half pint of turpentine, stirring it in gradually, after which add, also slowly, two quarts of the best white enamel varnish, copal, not damar. This ought to make one gallon of the best bath tub enamel.

Red Paint for Magnets.—Take one part of white or bleached shellac varnish and two parts of Venice turpentine, adding three parts of English vermilion to color. The Venice turpentine should be mixed with the shellac and set in a warm place until the turpentine has become liquid, the back part of the stove being a good place. After the two have merged and the mass is fluid, take it away from the heat and when it is about 140 deg., Fahr., thin with 95 per cent. alcohol, ten parts. Rub the dry vermilion to a paste with some of the liquid, or with alcohol, and add to the other mixture. Now set the mass on a water bath for a few minutes, then take it off and stir until cool. Place in a well-stoppered bottle and heat on water bath when wanted for use. Heat the magnet before applying the paint.

Paint for Metal Roof.—An imitation slate paint for a metal roof may be made upon this formula:

Lead zinc	20 lbs.
Whiting	10 lbs.
Cement	5 lbs.
Graphite	15 lbs.
Lampblack	1 lb.

Mix with three gallons of boiled linseed oil.

This will produce a dark gray slate color, and may be made a fine deep olive green by substituting two to five pounds of chrome yellow for the black. Thin this paint with boiled oil. If the paint is to be used on shingles thin out with kerosene one part and boiled oil two parts. It should be said here that the kerosene oil does well in this paint on wood, but fails on metal. This because the kerosene cannot penetrate the metal.

Paint for Smokestack.—Mix graphite, pulverized, with coal tar and thin out with kerosene to the proper brushing consistency. The coal tar will stick all right, even with the coal oil thinning. Graphite paint alone is good, or coal tar alone.

Paint for Bird Cage.—Never use white lead for this purpose, as it is poisonous. Mix zinc white to a stiff paste with pale copal varnish, and thin out with turpentine. The cage maker enamels the paint on the cage, and this you can do if you have access to a

kitchen oven of right size; 150 deg. heat is enough, maintaining it at that point until the process is complete. The heat required for such work is about the same as for baking bread.

Good Paint for Iron Work.—A paint chemist gives the following formula for ordinary iron or steel work. Take the best French yellow ochre 39 lbs., and lampblack 1 lb., both ground in oil. Thin with raw linseed oil 54 lbs., and japan drier 6 lbs.

Bronze Green for Iron Railings.—Sift and mix together in the dry state, and then mix with 5 oz. japan the following: 2 lbs. chrome green, 1 oz. lampblack, and 1 oz. medium chrome yellow. This should be ground in a paint mill, then thin out with raw oil to a brushing consistency.

Soapstone Paint.—Mention has been made in another chapter of soapstone or steatite as a paint pigment. It should be further said about it that a paint can be made with it alone, though usually it is added to paint containing other pigments. It has been recommended for iron railings or iron work in general, as well as for wood. It does not seem to be affected by the weather as other paints are, heat, cold or frost, gas or acids not affecting it at all. With varnish it makes a fine enamel paint. The paint flows and sticks well.

A White Paint for Stoves.—Obviously a paint to do well on a stove, particularly the hot parts, must be

fire- and heat-proof. Here is a formula furnished by a paint chemist:

(a) 16 fluid ounces waterglass solution, 36 B.
6 fluid ounces of water.
2 fluid ounces white sugar sirup.

(b) 8 ounces China clay.
2 ounces pulverized soapstone.
2 ounces dry zinc white.

Mix (a) and (b) together. Applied when the stove is cold; after the stove becomes hot the paint will turn to a light gray, but finally it becomes white. By leaving out the sirup the paint becomes white at once. The purpose of the sirup is to prevent the waterglass (sodium silicate) setting up too quickly. Ordinary light colored sirup would do as well and so save the costly and scarce sugar.

Painting a Stove with Aluminum.—Mix aluminum powder with ordinary copal varnish, thinning with turpentine. Have the stove perfectly clean. An expert painter has used this formula with great satisfaction, and has used it equally well on school radiators, the finish looking well at the end of five or six years. The top of the stove will of course need renewal once in a while.

To Paint on Copper.—Copper does not take paint well and must be prepared for it. Make up and apply a solution of copper sulphate and add a little nitric acid in water. This will slightly roughen the

copper and so afford the paint a foothold. Some use acetone one part to benzol two parts.

To Paint on Sheet Lead.—Paint does not adhere to lead without some preparation of the surface. One way is to rub it with fine sandpaper, but it is rather the nature of lead not to take paint, so that a coat of varnish is sometimes advised as a first coat. Certain pigments do better on lead than certain others; for instance, iron oxide paint does well, while ochre and other earth pigments do not.

Elasticity is an important feature of a durable paint for metal, and this depends more upon the thinners than on the pigment. A proper mixture of the two gives the best results.

Dry oxide of iron, or metallic brown, as it is also known, will require as much as 15 gallons of oil to bring it to the right consistency for application, where the same amount of red lead will take from 3 to 4 gallons only. In this case it is to be noted that the red lead is a more elastic pigment than iron oxide.

When Paint Livers or Thickens.—Some pigments are alkaline, and when mixed with oil saponification takes place; the oil and alkali form a soap. Such soap, however, is really a drier, the soap being a metallic soap; paints in which such soap is formed dry readily to a hard film. In some cases they dry rather too readily the result being checking and cracking, just as occurs when too much strong driers are used.

The way to prevent such saponification is to use inert with chemically active pigments, if it be possible. This is why we advocate adding barytes, an inert pigment, to white lead compounds.

Why Yellow Ochre Primer Peels.—Ochre is of a very hard nature, and when applied as a priming coat and it becomes quite dry, the film of paint is so hard that the following lead and oil coat will not adhere to it. It is always best to prime woodwork with white lead primer.

Spotting of New Paint.—This occurs often and usually the painter does not know the cause. It is the result of faulty surface, some parts soft and other parts hard; the paint sinks into the soft parts and not into the hard parts, in consequence of which there will be spots showing where the paint disappeared and where it remained. To remedy this go over the surface after the priming is dry with a touch-up coat, painting the parts where the primer coat has sunk in. When the touching-up paint is dry apply the second coat as usual.

Laps, due to improper painting, or brushing out, are apt to fade out and show spotty; the laps will be more pronounced owing to the heavier coating there. The laps show worse after a few months than at first.

If the Paint Runs.—There are at least two causes for paint running. If the paint is thin and you try to get it on to cover like a heavier paint would cover

it is bound to run. If the pigment composing the paint is too coarse or of heavy gravity the paint will run unless brushed out well. A third cause may be found in the use of a paint that has been mixed too long, or until it has become fatty. Again, if you use an oil that has some petroleum oil in it the paint may run, owing to the film remaining undry too long; the quicker a paint sets the less the danger of running.

Why White Lead Chalks.—The well known chalking of exterior white lead paint is peculiar to lead and does not in any way imply that the paint was not of the best quality. The addition of whiting as an adulterant would not increase its tendency to chalk. It would mean simply less lead and more oil, and be equivalent to a thin coat, which could, perhaps, be applied just as well without the whiting. Whiting in oil has practically no body, being therefore a useless adulterant of white lead except to prevent running. With red lead the case is different.

When the Paint Frosts in Winter.—If paint is applied and is undry when evening comes, the frosty air of night may destroy the gloss and make the surface paint very unsightly. It may restore the gloss if you will rub it with an oily rag, using linseed oil.

Adding Whiting to Red Lead.—The addition to red lead of whiting causes no change of color or quality. Whiting is a very weak white color, and cannot alter any color to which it is added. The addition of whit-

ing to red lead paint serves to keep the heavy paint in suspension and to prevent it from running when it is applied to iron.

Varnish in Exterior Paint.—Varnish is very seldom used in exterior paint, and when so used it is for the purpose of hardening the film, as in porch floor painting. Varnish serves safer in flat than in oil paint.

When Salt is Met With.—Having a warehouse, in which salt is stored, to paint, the painters met with trouble by the salt affecting the paint. If damp then the salt is wet. We can take a hint from ships which carry salt as cargo. Such ships are of iron or steel construction, hence liable to rusting in contact with salt and damp air. The owners have them painted with red lead paint. We presume that the first coat on the warehouse work should be red lead paint, and some of the red in the second coat.

Iron Oxide Paint Loses Luster.—What is the cause? Loss of its luster often occurs with this paint, when mixed with raw oil and when some turpentine has been added. Thin up with boiled oil, add a little exterior varnish, and avoid raw oil.

When Lead Becomes Hard.—Lead becomes as hard as stone when left unprotected with oil, and to get it in shape for mixing it must be heated. This may be done by pouring hot water over it and allowing it to stand on the back part of the stove a few hours, or by dry heat; the first way is best. It will become

soft, but must be mixed while hot or warm before it gets cold, when it would again be hard. Soften hard putty in the same way.

To Make Flat Wall Paint.—Take 50 lbs. of gilders bolted whiting and place in suitable vessel; pour cold water on it until the surface becomes covered. Let stand say over night; in the morning pour off the surplus water, then stir the mass with two gallons of hard oil or gloss oil; add any desired color, ground in water. Thin down for use with benzine or turpentine, according to what you have in mind in the way of cost. This paint will dry without gloss, and it is a cheap wall paint.

Cheap Dark Paints.—A paint that may be used where a better or higher priced paint is not desired may be made from two parts of dry Venetian red to one part of gilders whiting. Mix to a paste with raw linseed oil and thin out with a mixture of one part benzine to three parts of raw oil, adding also $\frac{1}{7}$ of total quantity of above liquids of gloss oil. Mix a pound each of bicarbonate of soda and sodium phosphate in hot water and mix with the paint. Another cheap paint is made thus: Mix together one part of dry Venetian red and three parts of ochre; add some white lead to give the paint more body. About one part lead will do. If the color is too bright add some black to subdue it. Thin up with any cheap thinners.

When the Paint Becomes Thin After Mixing.—This

can be caused when pulp lead is used, by the water in the pulp, and which should have been eliminated when made, the water forming an emulsion with the lead and oil. There is also another cause, the presence of excess of hydroxide in the lead.

Grain Paint.—This old-timer may be made by boiling two pounds of rye flour, and while boiling adding two pounds of thinned oil paint, stirring until a perfectly mixed compound results. Good for old exterior surfaces; one or two coats.

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